

MACHINERY.

September, 1906.

AN EXPERIMENT IN INDUSTRIAL TRAINING.

THE APPRENTICESHIP SYSTEM OF THE GENERAL ELECTRIC CO. AT WEST LYNN, MASS.

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THE industries of our country, especially in the mechanical lines, have grown wonderfully since 1893, when the nations of the world exhibited the products of their skill at Chicago and gave thereby a new impetus to the ingenuity and enterprise of the American people. The whole industrial life of the country has, accordingly, undergone tremendous changes within the last decade. Specialization has become the established principle in all industries. Where, heretofore, an all-round artisan, by the skill of his hands, performed the different operations which created the finished product, to-day many different machines, each designed for one particular operation, are required for the wholesale manufacture of a single article.

It would, therefore, appear that the all-round skilled artisan was less in demand. This, however is not the case. The enormous expansion of modern industries demands a larger number of skilled workmen than formerly in spite of the advanced degree to which specialization has been carried. The introduction of automatic machinery and specializing processes calls for a new type of skilled employee, one who possesses not only manual dexterity and a practical knowledge of the principles underlying his work, but also an understanding of the machine and the material worked upon, together with the ability to repair machinery when it gets out of order.

When manufacturers began to realize that, through the process of specialization, they were enabled to use a larger proportion of unskilled and semi-skilled workers in the extension of their business, they paid less attention to the question of constantly renewing the supply of skilled workers. In consequence of this the scarcity of skilled labor has become more and more apparent in the last few years. In the mechanical trades especially the scarcity has reached the point where the further development of American industries is seriously threatened if proper steps for relief are not promptly taken.

The problem which has thus been created by the changed industrial system is one that concerns not alone the manufacturer; it has become a problem of the State, which is charged with the duty of educating the children in such a manner that they may not only possess the instincts of good

citizenship, but may also be enabled to become self-supporting members of the community. Manufacturers are taking hold of the problem principally by reviving the apprenticeship system along lines which meet the new industrial conditions. The claim often made that the apprenticeship system is dead is, therefore, not sustained. It would be correct, however, to state that the "old" apprenticeship is dead; so are the old factory methods dead, and the old ways of manufacturing also. A new method of manufacture has come

into existence and a new factory system has been developed under new industrial conditions. This has necessitated a new system of apprenticeship to fit the altered conditions. Apprenticeship has always existed, for a new man had always to be taught the trade. But as all industrial activities to-day are being carried on under more systematic and more centralized leadership, so do we find that manufacturers are introducing a more systematized apprenticeship where whole groups of boys are initiated into a trade under centralized direction. In doing so manufacturers are partly bridging over the gap which exists between the equipment which the boy receives under the present school system and that which modern industry demands of him. It is not sufficient, however, to

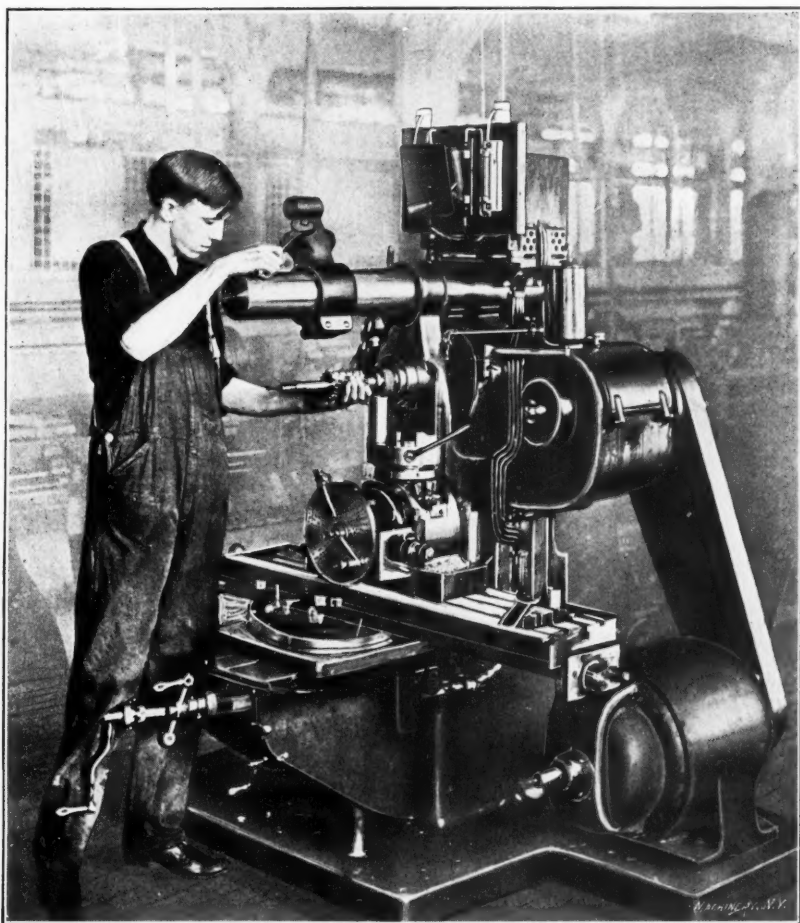


Fig. 1. An Apprentice and his Machine.

bridge over the gap; the gap ought to be eliminated, and this is essentially a function of the school.

What causes the gap? A growing lack of respect for manual work and, therefore, a diminishing desire to learn trades and an inadequate training of those who wish to enter industrial life at an early age. The schools must instill the boys with interest in and respect for manual work by emphasizing more than they do now, the importance of hand work, especially in the lower grades of the schools. Greater numbers of boys would then be directed into the mechanical trades and would be prevented from filling poorly-paid unskilled positions, thereby recruiting the army of the unemployed whenever a slight depression disturbs the economic conditions of the business world.

The educational system should then accommodate itself more fully to the new industrial conditions. The efforts of manufacturers in industrial training must, after all, be looked upon as experiments only, highly important however as an

immediate remedy; but these are experiments which the State ought to watch with a deep interest, in order to draw therefrom proper conclusions as a sound foundation on which to build the right system of industrial education.

One of these experiments is the apprenticeship system of the General Electric Company at West Lynn, Massachusetts, which I shall briefly outline, because it has been proved successful since its inception in February, 1902, and in some of its novel features contains elements of adequate industrial training. Under this system, boys of at least 16 years of age with a grammar school education are indentured as apprentices in one of the many trades which are practiced at the works at West Lynn. Applicants have to serve a trial period of from one to two months, during which time they are

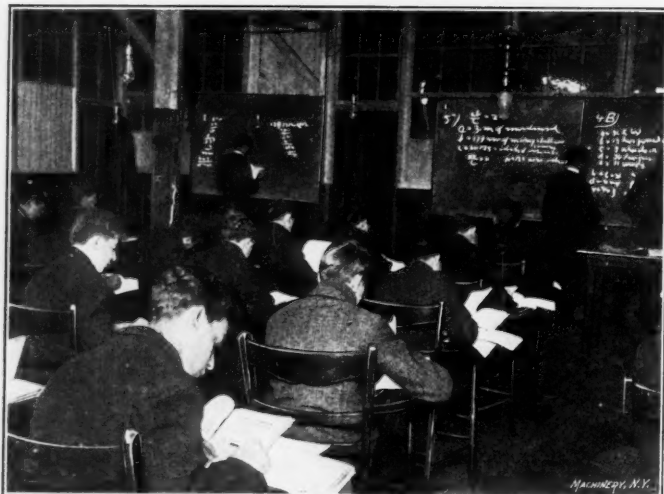


Fig. 2. The Class in Mathematics.

under the close scrutiny of a man qualified to observe the makeup of the boys as to mechanical ability and general disposition. Only those who, during the trial period, give promise of becoming good artisans with a fair expectation of being able to occupy, at some future time, leading positions in the factory organization, are allowed to sign the regular apprenticeship agreement. This agreement provides for a service of four years, during which time apprentices are paid fair wages along a progressive schedule, and are given every opportunity to learn the mysteries and arts of the particular trade to which they have been indentured. The wage schedule is set so that each boy can be self-supporting from the beginning, even during the trial period. In round figures, apprentices are paid during this period and during the first six months \$4.50 per week; during the second six months \$5.60 per week; during the second year \$6.70 per week; during the third year \$7.80 per week; and during the fourth year \$9.25 per week, with a cash bonus of \$100.00, dependent on the successful termination of the apprenticeship.

The aim of the General Electric Company is not only to develop skilled machinists and tool-makers, carpenters and pattern-makers, iron, steel, and brass moulders, instrument makers and electrical workers, but also to develop a class of artisans from which men may be chosen for leading positions in the factory, such as assistant foremen, foremen, master-mechanics and superintendents. To hold such positions requires more than the dexterity of the hand; a familiarity with the practical sciences involved and a knowledge of the ways and means of conducting the work in a businesslike manner, become an essential part of the equipment.

The Theoretical School

The General Electric Company has, therefore, recognized the necessity of educational instruction, given along with the manual instruction, in such a manner that the apprentices may apply every day in the factory what they learn in the study room. This happy correlation of theory and practice cannot fail to produce satisfactory results, especially since the theory is explained in an eminently practical way and the practical work is conducted along educational lines.

The boys attend theoretical school twice a week, each ses-

sion lasting 2½ hours. These sessions take place during working hours—at the present time in the latter part of the afternoon—and apprentices are paid the same wages during the school hours that they would receive if they were working at the bench or at the machine. Those of the boys in whom therefore the commercial spirit predominates, will be just as anxious to go to school as those who are really desirous of educational development.

The comparatively small amount of time devoted to instruction does not permit the instructors to go very deeply into the subjects which are taught. In fact, a large part of the teaching is only a review of some of the grammar school work, applied, however, to practical factory conditions. Our public schools have taught the boy a great amount of knowledge and have committed to his memory many rules and formulas, but when it comes to the application of this knowledge and of these formulas to practical uses, boys often find themselves "up against it," because they have not acquired the faculty of independent and logical thinking. The review aims then to instill into the boy this habit of independent and logical thinking; but while it refreshes his memory on the elementary sciences of the grammar school programme and teaches him the application of these sciences, it also gives him an insight into technology. He is made to become familiar with technical terms, technical processes, the materials used in the factory and the finished products manufactured.

All problems are of a concrete nature and deal with materials, apparatus or parts thereof, which are used in the factory. The teacher is obliged to hold in his hand, as it were, the material or apparatus of which he speaks, and to explain briefly the nature and use of the object. There is no better aid to the understanding or better help to the retentive memory than to demonstrate "ad oculos." The course of study embraces mathematics, physics, technology, and mechanical drawing.

MATHEMATICS: This subject, as taught, covers arithmetic and algebra, plane and solid mensuration and trigonometry.

Arithmetic and algebra are taught alternately as far as each process is concerned, beginning with the elementary processes in whole numbers, decimals and common fractions and continuing through percentage calculations and problems



Fig. 3. Studying Machine Design.

in ratio, simple and compound proportion, square and cube root, leading on to the application of these subjects in useful formulas. These are given to the boys as facts to be accepted for the present, but which will come up again later on in the teaching of physics, thus making the study of that science much easier. The alternating of arithmetic and algebra has proved an undoubted success, in that it makes the school work more interesting to the boy and calls into play his reasoning faculties right from the beginning.

Mensuration is dealt with similarly in that it teaches the properties of straight lines and angles, planes in space and solids, like triangles, polygons and prisms, circles and cylinders, cones and spheres. The knowledge thus gained is

applied to practical problems in figuring weights of machine parts and whole machines.

Only a short time is devoted to trigonometry, which deals principally with angular measures, and the properties of right and oblique triangles.

As stated before, only concrete examples applicable to factory conditions are given, which, together with the method of teaching algebra and arithmetic alternately, keeps the boys' interest in the school wide awake. It is but a test of the boy's memory to ask him for the cubical contents of a cylinder $\frac{1}{2}$ inch in diameter and 25 inches long, but it is an entirely different test if we put the same problem in the following manner:

"A machine shop is ordered to produce 35 steel pins, each of which is to be $\frac{1}{2}$ inch in diameter by $\frac{3}{4}$ inch long. The



Fig. 4. A Corner of the Apprentice Shop.

pins are to be cut from a long steel rod and the tool for cutting off will waste $\frac{1}{16}$ inch material between each two pins. What will be the weight of the steel rod required?"

This is a problem which we meet in every-day factory life and which involves nothing else than plain multiplication and addition. It is simply a question of multiplying 35, the number of pins, by $\frac{3}{4}$ inch, the length of each pin, and adding to it 34 times $\frac{1}{16}$ inch, as the amount wasted by the cutting-off tool. The result will give the length of the steel rod required, which must now be multiplied by the area of a $\frac{1}{2}$ -inch circle in order to obtain the proper cubical contents which, when multiplied in turn by the specific weight of steel (a figure which we give to the boy), will give the total weight of the steel rod.

Now we could ask the boy who has this particular problem in hand for the result of his calculation, and tell him that he is wrong if he does not obtain the proper figure; this procedure may, however, create an attitude of antagonism toward the teacher. We, therefore, hand the boy a pair of scales, by which he may check his own results. He will feel rather ashamed if the scales tell him that he is wrong and he will immediately recalculate the problem with the earnest desire to arrive at the correct figure. The boy has, so to speak, a greater confidence in the veracity of the scales than in the veracity of the teacher.

PHYSICS covers mechanics, applied engineering, heat, magnetism and electricity.

Mechanics deals with elementary machines, such as simple and compound levers, the inclined plane, wheel and axle, screw, pulley, and wedge and with the combination of these. We deduce the general laws underlying elementary machines from experiments made on models, and clinch the knowledge thus gained by the solution of practical problems involving the use of these elementary machines.

Applied engineering deals with the review of mechanics and mathematics on problems which factory foremen have to solve, such as the calculating of proper gears to put on a lathe in order to obtain certain cutting speeds. This gives an opportunity to explain the nature and use of a lathe and

incidentally to explain the general laws which govern friction and lubrication, work, energy, power, etc.

Magnetism and Electricity is taken up in a similar way by laboratory experiments, from which the general laws are deducted. Our whole factory serves as a big laboratory; this being, perhaps, a finer and more complete laboratory than any educational institution can boast of.

TECHNOLOGY, in the beginning, is an effort on our part to correct some of the glaring defects, where such exist, in spelling and English composition. Unfortunately "steel" is too often spelled "steal." We acquaint the boys with the spelling of technical words and then instruct them to express themselves orally and in writing in a clear and concise manner. This instruction is elaborated by the dictation of short essays on the properties and uses of the different materials with which the engineer has to deal, and of the different apparatus which our company manufactures. Occasionally the boys are asked to write short compositions explaining why certain materials ought to be used for the construction of certain machine parts and machines. Technology in the advanced classes is given in the form of lectures by our engineers and shop foremen on such subjects as the care of machines, the principles of pattern-making and foundry work, the methods used in stock-keeping, etc.

MECHANICAL DRAWING, to which a large portion of the time in school is devoted, is considered a very important subject. First a brief course in free hand sketching is given; the art of free hand sketching of geometrical figures is not sufficiently developed in our schools or even in our higher schools of technical learning, although it is a very important equipment for anyone engaged in industrial pursuits, whether he is a skilled workman or a foreman, or occupies a position as an engineer or superintendent. After this follows a course in mechanical drawing, which includes instruction in descriptive geometry and teaches the proper handling of drawing and measuring instruments, the making of straight and curved lines, geometrical constructions, and orthographic projection. Then follows a course in machine design, where boys are given parts of machinery, such as bolts, and screws, shafts and pulleys and pieces of like description, which they are obliged to measure by means of calipers, scales and micrometers, in order to make proper free hand sketches with the necessary

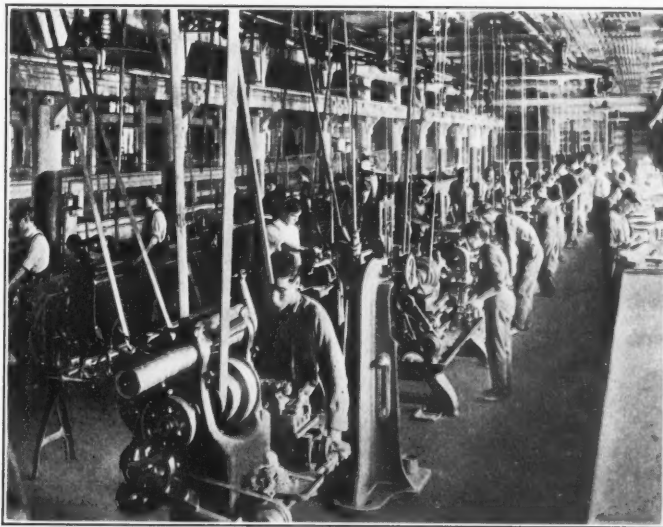


Fig. 5. Looking Down one Side of the Training Room.

dimensions. These free hand sketches serve as a basis for making regular mechanical drawings with elevation, plan, and cross-sectional views. The last, and, from our standpoint, the most important part of mechanical drawing, deals with tool design. It develops the ability to design the auxiliary tool equipment required for specific operations in manufacture on a large scale. A flange coupling, for instance, contains 4 holes, which may be drilled accurately and quickly by semi-skilled workmen if an appropriate jig or holder is provided therefore. The boys, who, by this time, have already had some years of shop experience, are asked to design such a jig according to their own ideas. The designs produced indicate the individual

mechanical ingenuity of the different boys and are discussed by the teacher from the standpoint of good and bad features of design. This part of mechanical drawing is not, and for that matter cannot, very well be taught in the public schools, although a proper knowledge of it is of very great assistance to a skilled journeyman, foreman, superintendent, or engineer.

This in the main covers our school programme, which is carried out by instructors selected from those of our own engineers, draftsmen and foremen who have pedagogical ability. We select the teachers from our own staff because they know what our factory requires and can, therefore, impart this specific knowledge to the boys better than it could be done by professional teachers who are not engaged for at

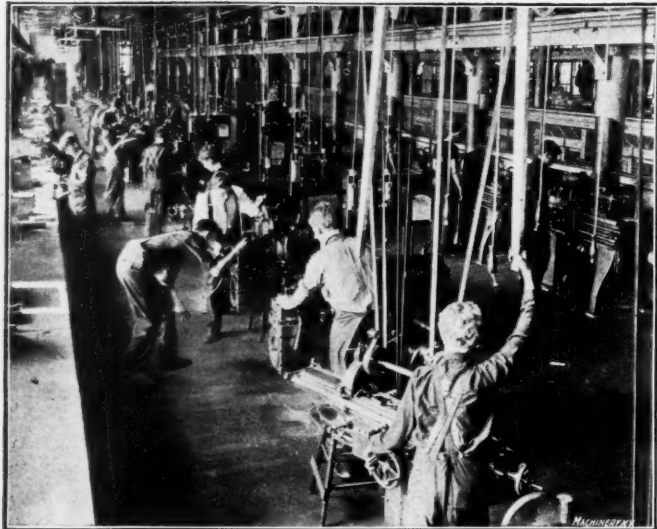


Fig. 6. Lathes, Shapers and Grinding Machines in the School Shop.

least part of their time in the actual work of our factory. We bring thus the factory into the school room, as we have also successfully brought the school room into the factory, in the practical instruction which we give to the apprentices.

A Special Shop for Apprentices.

It is the usual practice in apprenticeship systems to assign a boy to one of the factory departments, in which the foreman or his assistants are supposed to teach him the particular work of the department. He is then transferred to another department for the purpose of learning the different kinds of work performed there. It is easily realized that shop foremen and their assistants are very often not qualified to impart knowledge in a satisfactory manner, and, besides, very often cannot give the apprentices the opportunities that will lead to the quickest and best results. One department may be busy and may, therefore, offer to the boys splendid opportunities, while another department, due to productive requirements, may have only a small amount of work on hand, of a kind which does not give the apprentices a really good chance.

In order to equalize and improve these conditions and thoroughly initiate all the boys into the trade, and especially in order to teach the work in the best manner, we have set aside a small shop in our big factory, devoted entirely to the preliminary practical instruction of the apprentices. This apprentice training room which, I believe, is the best example of a trade school, is presided over by a man who is eminently qualified by training and capacity to launch the boys upon the right course. He is an ingenious mechanic who has himself served an apprenticeship, takes a deep interest in the boys, and understands how to guide and instruct them properly. He has the opportunity during the trial period to study closely the boys' makeup, so that he may drop from the course all who do not display the qualities which are essential for a successful career. It is his duty to develop an inventive capacity in those who by nature are endowed with inventive minds, and to arouse in the apprentices interest in and respect for manual work.

The training room contains representative machines, some of which are of the latest design and are modern, up-to-date

tools, while some are old worn-out machines which have been rescued from the scrap heap. It is understood, and it is almost hoped, that these old machines will break as soon as the apprentices try to perform work on them with a fair degree of speed. Such breakage, however, gives a splendid opportunity to instruct the boys in the repairing of machinery, which is the best instruction which can be given them, because it teaches presence of mind, self reliance, and the ability to do things. An apprentice should not wait for a new gear, if a tooth in an old gear breaks, but he should be able to apply the dentist's art, if necessary, and insert a new tooth in the gear and make the wheels go around again without much loss of time. Some of the old machines have thus been repaired and repaired until to-day they have become good rivals of some of the new tools which have been bought lately direct from the tool manufacturer.

All work in the training room is work of commercial value, which is of great psychological importance in the development of the apprentices, as it takes them out of the sphere of laboratory work into that of real industrial life. It undoubtedly makes a difference with a boy's zeal as to whether he performs some work that is to be a plaything only, or may even go into an exhibition case, or whether he manufactures a piece which has a useful function to perform in some machine.

A Post-graduate Shop Course.

Every apprentice has first to enter the training room, where he is put on bench work and then on work on simple machines, after which he is advanced to work of a more difficult character on simple and then on more complicated machine tools, until after about two years' time he has sufficiently mastered the art so that he can be sent into the different factory departments to serve the last two years of his apprenticeship as a post-graduate course, where he may acquire greater skill and accuracy on a greater variety of work, together with the ability to meet emergencies as they arise.

But even during the post-graduate course every apprentice is followed up by the man in charge of the training room, who transfers apprentices from one department to another as seems advisable. The individuality of every apprentice begins to show itself to a greater degree and this is taken into account

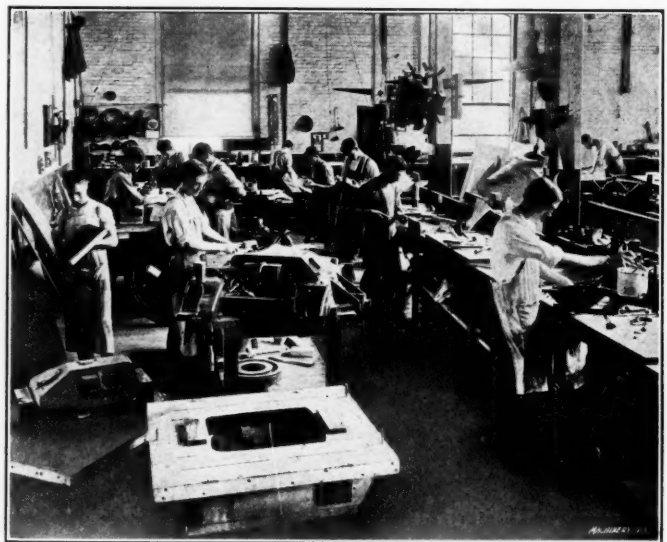


Fig. 7. Apprentice Patternmakers at Work.

in directing his further course of work. Apprentices are now entirely under the discipline of the factory foremen, yet they feel that their former instructor continues to take a lively interest in them and that they, therefore, may go to him for advice and encouragement. The foremen, on the other hand, co-operate with the instructor in order to utilize his influence over the boys to spur on one apprentice to greater accuracy, another to greater speed, and to overcome some of the little difficulties of a disciplinary nature that are liable to arise.

We have at present about 75 apprentices in the training room, with nearly double that number in the post-graduate course in the factory. Only one instructor with one assistant looks after the practical instruction in the training room.

This small amount of supervision is made possible by our method of training the boys themselves for the functions of assistant instructors. When a young apprentice has thoroughly learned an operation, the turning of pulleys for instance, he is, as a rule, required to break in a new apprentice on this kind of work before he himself is allowed to be taught by a still more advanced apprentice how to bore pulleys. The apprentice, therefore, is pupil to-day and teacher to-morrow, then pupil again and then teacher once more. This procedure has a double advantage; the boy acting as teacher will put forth his very best effort to impress favorably his younger co-worker with the knowledge which he has already acquired, and the young recruit will not hesitate to ask his boy teacher questions which he might hesitate to ask the regular instructor. The boy instructor is thus educated step



Fig. 8. Studying the Moulder's Art in the Brass Foundry.

by step along lines of imparting knowledge to others—a qualification found only in a very small percentage of otherwise skilled artisans—and the boy recruit sees, immediately, the possibilities of further development and advancement. During the last few weeks of their stay in the training room, some of the best apprentices act as regular assistants to the instructor, looking after the discipline of the room, the proper way of handling orders, and the general supervision of the work.

It is the policy of the General Electric Company to retain the graduated apprentices in its service and whenever a "Certificate of Apprenticeship" is handed to a boy at the termination of his course, he is given a substantial increase in his wages and is encouraged to remain as a full-fledged journeyman and, in some cases, even as an assistant foreman.

* * *

The *Southern Engineer*, speaking on the subject of cylinder lubrication, mentions a certain engine builder whose pet idea it was that no oil is needed in the valve chests and cylinders of engines. In carrying out his idea he was accustomed to go to the extent of forbidding the use of oil or grease when boring and tapping, claiming that if no lubricant was allowed to touch the iron, the condensed steam would adhere to the metal and take the place of oil as usually used. He allowed, of course, no holes to be drilled in the steam pipe of the engine installed in a local plant was taken apart after several years' use, stalled in a local plant was taken apart after several years use and the cylinder and valve seat were found to be in excellent condition. No perceptible wear could be detected by the use of calipers and straightedge. While this is very good proof of the engine builder's idea that oil is unnecessary as a preventative of wear, it is not an argument for abandoning the use of a lubricant in steam engine cylinders. It was shown, when the indicator was applied to the engine, that the steam consumption was far beyond what it should be. After several years' use under the conditions just described a lubricator was attached to the steam pipe, when a saving of one-third of a pound of coal per horsepower per hour was effected.

BRAKES.—2.

CLAM SHELL OR BLOCK BRAKES.

C. F. BLAKE.

The type of brake known as the clam shell or block brake, Fig. 3, is often used in place of the band brake, over which it possesses the advantage of even wear on the blocks, and positive release, although not possessing so great gripping power.

The cast arms, A and A_1 , are pivoted at o to the frame of the machine, and carry blocks formed to grip the brake wheel. Links L connect these arms to the bell-crank B , having the floating center n .

To lay out this brake to the best advantage, draw from o lines through the center points of contact, a and a_1 , on the rim of the wheel; also from o as center draw arc cc , cutting these lines at points c . At these points draw tangents to arc cc , intersecting at u , and draw us , bisecting angle gug' . Select a point n upon us for the center of circle b , drawn tangent to eg , such that the required leverage will be obtained for the brake system as explained later.

Now referring to Fig. 4, which is a diagram of Fig. 6, we have as the force A in the link L ,

$$A = \frac{P \times sn}{2ng}$$

n being the instantaneous center for the bellcrank B .

This force, A , resolves into d and m as shown, only one link being so drawn in the diagram, although both links are alike in this respect. The arms, A , are bent levers, fulcrumed at a , loaded at e with the force in the links, and at o by the reaction of the pivot.

The reaction at this point is,

$$F = \frac{A \times ea}{ao}$$

and resolves into h and u .

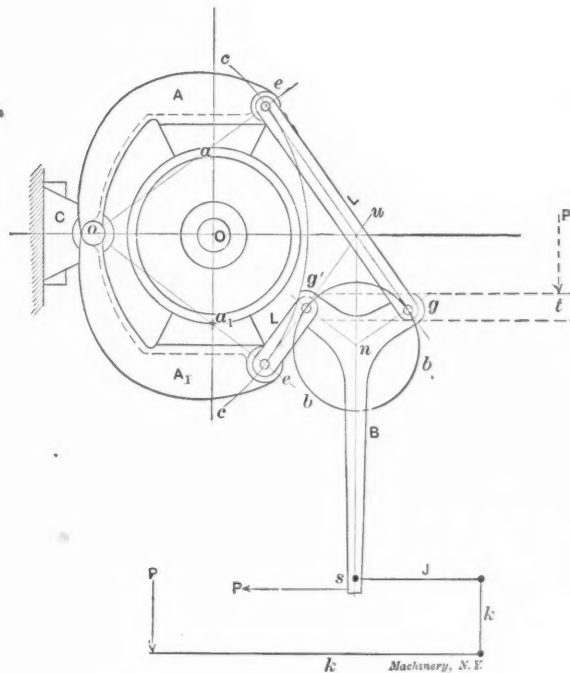


Fig. 3. Construction of the Clam-shell Brake

Then the load D at the fulcrum a is,

$$D = A + F$$

and D resolves into ab and bf .

This is also true of the lower links and arms, resulting in D_1 and a_1c_1 . Now let bc represent that portion of the weight of the arm A , link L , and blocks resting upon a . Then we have for the total normal force at a ,

$$B = ab + bc$$

and at a_1

$$B_1 = a_1c_1 - b_1c_1$$

also,

$$B + B_1 = ab + a_1c_1$$

the corresponding horizontal components being C and C_1 .

and the arc $tf = .01745 \alpha r$. Substituting these values in (8)

$$\Sigma F = \frac{B \sin (2 \theta) r .01745 \alpha}{4 r \sin \alpha} = \frac{B \sin (2 \theta) .01745 \alpha}{2 \sin \alpha} \quad (9)$$

The moment of friction, or the retarding torque is then,

$$T = R B \frac{\sin (2 \theta)}{2} \frac{.01745 \alpha}{\sin \alpha} = R B \frac{k}{2} K \quad (10)$$

for a brake of one block, such as car brakes, and

$$T = R B \sin (2 \theta) \frac{.01745 \alpha}{\sin \alpha} = R B k K \quad (11)$$

for two block brakes, such as shown in Fig. 3, when

T = torque in inch-pounds,

B = pressure on blocks, in pounds,

α = angle at drum center included by blocks,

θ = angle of rest for materials of drum and blocks,

R = radius of drum in inches,

$k = \sin (2 \alpha)$

$$K = \frac{.01745 \alpha}{\sin \alpha}$$

The following chart gives values of k and K corresponding to the small range of values of θ and α usually used in these brakes.

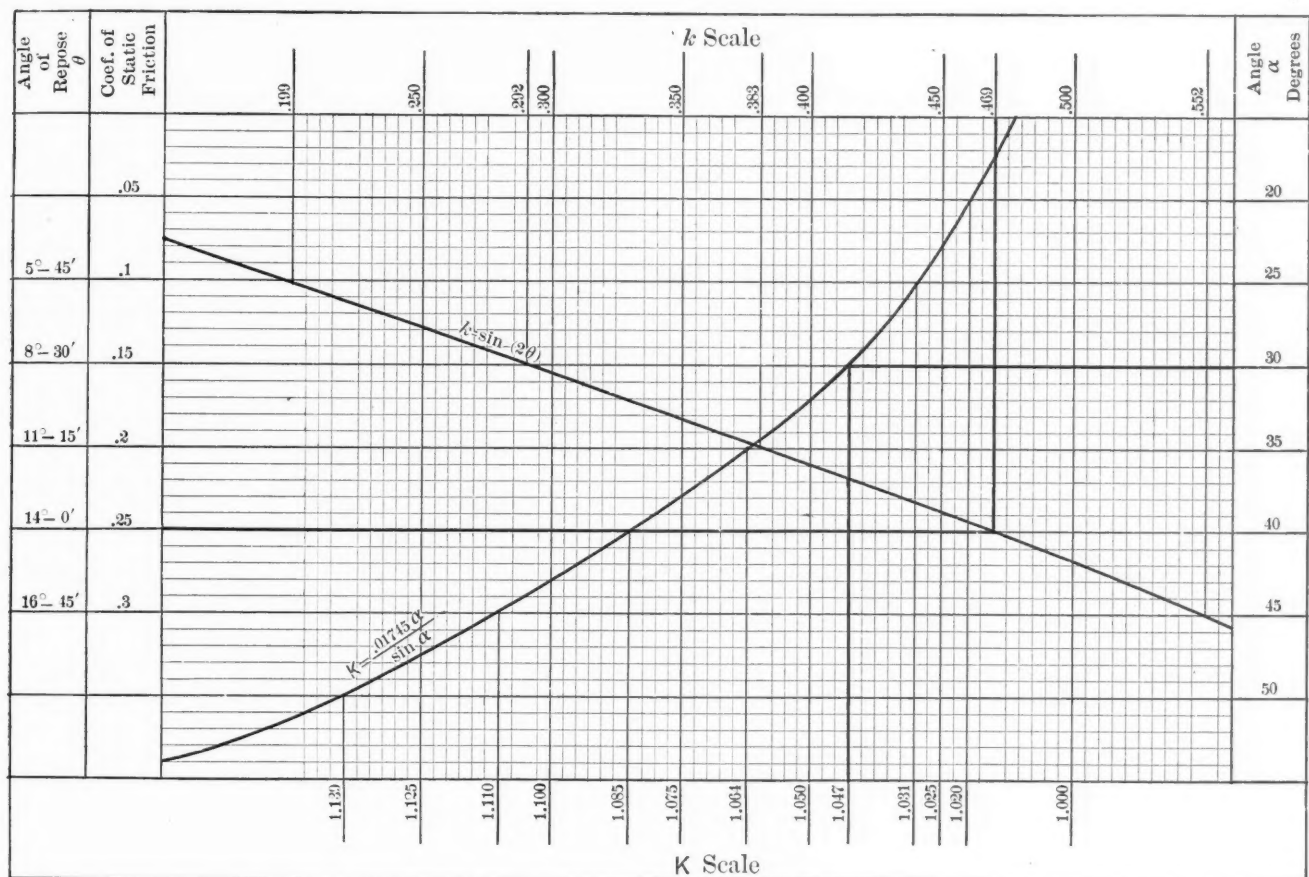


Chart for Use in Designing Clam-shell Brakes.

Machinery, N. Y.

Example: A brake having two wooden blocks subject to pressures of 500 pounds, and a cast iron drum 20 inches diameter, the angle 2α included by each block being 60 degrees, α being 30 degrees, and the coefficient of static friction being .25 corresponding to an angle of rest of 14 degrees.

The readings of the chart for the problem are shown in heavy lines, and we find $k = 0.469$ and $K = 1.047$.

Then from (11)

$$T = 10 \times 500 \times 0.469 \times 1.047 = 2,455 \text{ inch-pounds.}$$

Fig. 3 shows no device for adjustment for wear. This is accomplished in many ways, but should always be of the nature of an equalizing device. This prevents putting adjustment into links L as is sometimes done, it being impossible to adjust the two blocks evenly by this method.

The point F being a floating center, as shown, automatically adjusts evenly for wear, and when this construction is followed no further adjustment is necessary.

The bell crank B is quite commonly replaced by the straight lever $g_1 g t$ shown in dotted lines, although it is not good practice, since the load at g_1 is

$$P = \frac{P \times t g}{g g_1}$$

and at g is

$$P + p$$

resulting in uneven pressure on the blocks, the upper receiving the greater portion by the amount $P + 2w$, if w is that portion of the weight of the arms, links and blocks supported at a .

A better method is to keep the bell crank $g, n g$, and attach thereto another bell crank k by a link J as shown in heavy lines. Where there is room to place this construction beneath the brake as shown, it makes an excellent arrangement, and equalizes all pressures upon the blocks except that due to the weight of the parts.

It is, of course, necessary that the several forces and their resultants and reactions should form a balanced system, and that we should know the amount and direction of the resultant pressures upon the pivot point o , and the wheel shaft O .

Letting T = the retarding torque in inch-pounds, as before, we have in Fig. 3

$$E = \frac{T}{k}$$

also

$$p = \frac{P r}{k}$$

Thus we have upon pivot o the known forces E, p, F , and F_1 , and their resultant is R as shown.

Upon O we have $G = C + C_1$, P = the force applied at s , and H = the weight of the wheel and parts, and the resultant R_1 is as shown.

The point O may be placed below the wheel making the axis $a a_1$ horizontal, the arms H falling apart by gravity when released, and when the arms are not heavy enough to do this without having one of them bear against the wheel while the other is free, light springs may be attached to points e to keep them apart when released.

The arms are sometimes extended so that points *e* may be connected by a spring which sets the brake, the release being made by toggles separating the arms when applied. The wheels of these brakes may be made V-shaped, as explained for band brakes, and the same formula and table for the increased braking power applies. The blocks *k* are often made to embrace a larger portion of the wheel than shown, sometimes nearly 180 degrees.

In Fig. 7 are shown several types of this brake, the fixed points being shown by a dot within a circle, and the floating points by a plain dot. At *A* is shown a brake useful when there is no convenient way of pivoting the arms to the frame at *u*. The bell-cranks *ace* and lever *mn* are pivoted as shown but the point *u* is fixed in space only by its geometrical relations to points *a*. Since the arcs *s* and *t*, struck from the points *a*, cross at *u*, it is evident that the point *u* becomes fixed in its relation to points *c* where the system is connected to the frame, and thus *u* is the fulcrum of the arms *E*, although not the point which receives the thrust of the brake arms, this being taken at points *c*.

At *B* is shown a good type of brake, the feature being that both arms act as tension members in transferring the braking force to the fixed points *c*.

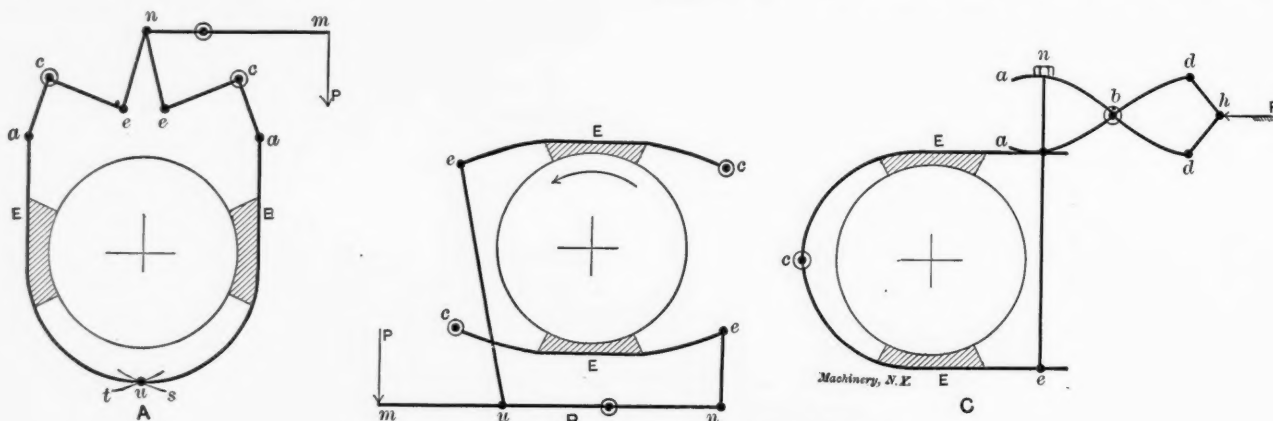


Fig. 7. Various Types of Clam-shell or Block Brakes.

At *C* is a brake set with a toggle composed of two bent levers, *abd*, fixed at *d*; the points *a*, being forced apart, press down on the upper arm *E*, and pull up on the lower arm *E* by means of the rod *cn*. The toggle forms an equalizing device, so that only one adjustment is necessary.

Types of this brake are often seen on electric traveling cranes in connection with solenoid operating devices, where they are mostly used as motor brakes to absorb the energy of the heavy rotating armature, and bring the motor promptly to rest upon the current being broken.

The solenoids on all such brakes are connected in series with the motor, so that when the motor is supplied with current, the solenoid releases the brake to allow the motor to hoist and when the current is broken the solenoid becomes inactive and allows the brake to be applied, either by springs or by gravity of a weight.

In placing these brakes upon a machine in which the source of power possesses great inertia, as the armature of an electric motor, the brake should be placed as near the source of power, and as far from the load as possible, thus giving the heavy rotating parts on the power side a minimum advantage over the brake, while giving the brake the maximum advantage over the load through the gearing.

* * *

THE GERMANS AND THE MARINE STEAM TURBINE.

The German attitude of conservatism toward the marine steam turbine is a subject of comment on the part of a German correspondent of the *Times Engineering Supplement*. The German engineers feel that there are a number of difficulties yet to be overcome before this form of engine can be considered a commercial success. The principal objection is the great speed at which it revolves, a speed which can only be reduced at the cost of efficiency. Even when reduced so far as practicable, it is yet too great to obtain economical pro-

pulsion from the screw propellers. The extra apparatus required for reversing is also considered to be a disadvantage. The reversing turbines must be of high power to change the direction of motion of a large steamer, and they must at the same time be economical, and this requires machinery which compares in size and complication with the apparatus used for the forward motion. For war vessels the turbine has the added disadvantage of being a one-speed machine. The war ship should be able to cruise economically at a comparatively low speed, keeping a large reserve power in readiness for high speed when in action. To run a turbine for any length of time at a rate much less than its normal one means a great drop in economy. A method suggested by Dr. Riedler recommends the employment of special electric motors, gas or oil engines for slow cruising, employing the turbine only for full speed or for work requiring a maximum efficiency. The largest and practically the only large marine turbine in Germany is the 6,000-horsepower engine of the steamship *Kaiser* in the Island traffic service of the Hamburg-American line, and this engine was constructed by the Allgemeine Electricitäts-Gesellschaft on their own account and was placed on the vessel with the expectation that the steamship company would ultimately purchase it. The German navy has only one small cruiser

and one torpedo boat equipped with turbines for experimental purposes. The official reports show very unsatisfactory results, but there is no reason to believe that these are entirely due to the use of the turbine, and they seem scarcely to justify the pessimistic judgment now current in Germany with regard to the replacement of piston engines by turbines on ships.

* * *

CALCULATING CENTRIFUGAL FORCE.

When the total centrifugal force has been calculated for a flywheel rim the result is analogous to that obtained when the total internal pressure acting on a certain length section of steam boiler shell is figured. But in neither case is the total the disruptive force acting to tear the parts asunder. For example, the total internal pressure on an inch-long section of boiler shell 50 inches diameter (157 inches circumference), pressure 100 pounds per square inch, is 15,700 pounds. The actual bursting or tangential stress is $15,700 \div \pi = 5,000$ pounds; this bursting stress is resisted by two thicknesses of the shell, one on each side. In the case of the flywheel the total centrifugal force developed in the rim as calculated by the formula $F = 0.000341 WRn^2$ must be divided by π to get the measure of disruptive force. These remarks are made in comment on the article published in the August issue; a wrong inference might be drawn from the paragraphs illustrating the use of the data sheet diagrams as nothing was said to indicate that the total centrifugal force must be divided by π to get the bursting force acting in the rim.

* * *

Large quantities of postage stamps are annually used for the transmission of small sums by mail because of their convenience and safety. But it is a practice not in high favor with firms getting them, for stamps are frequently received in almost unusable condition, especially in hot weather. A convenient form in which to send stamps by mail and one which practically assures their receipt in good order is in the shape of the stamp book now provided at all post offices in 12-, 24- and 48-stamp books, all in 2-cent denomination.

PLANING A SMALL MACHINE PART.

H. P. FAIRFIELD.



H. P. Fairfield.

The planer is in some respects one of the most interesting of machine tools. To quickly secure the pieces to be machined in such a manner as avoids springing them, and at the same time hold them fixed and firm against the thrust of the cutting tool, is seldom as simple a proposition as it might seem to be. The tool, while the cut is being made, tends to slide the work along the planer table in two directions for the horizontal plane, and beside this there is a tendency for the tool to tilt or tip the work. Any holding of the work must, therefore, provide against it moving, first, along the direction of the cut; second, across the planer table due to the pressure of the cut or feed, and third, to prevent any tilting. To furnish a method of fastening the work that provides for all these, and yet admits of quick handling, is that which in a manner differentiates one planer hand from another.

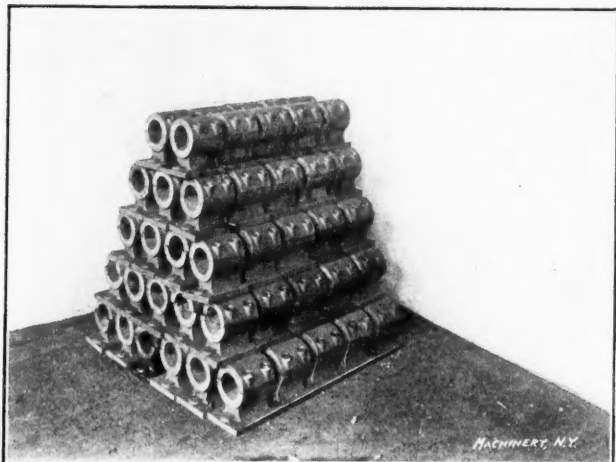


Fig. 1. A Pile of the Finished Parts.

Where the number of like pieces is large, it usually pays to design special jigs and fixtures with which to hold the work. This is especially true of small machine parts, and the fixtures are usually designed to hold a considerable number of pieces at one setting. Held in this way, setting the tool accurately for one piece sets it for the whole string of pieces, as it is termed. On the other hand, spoiling one piece

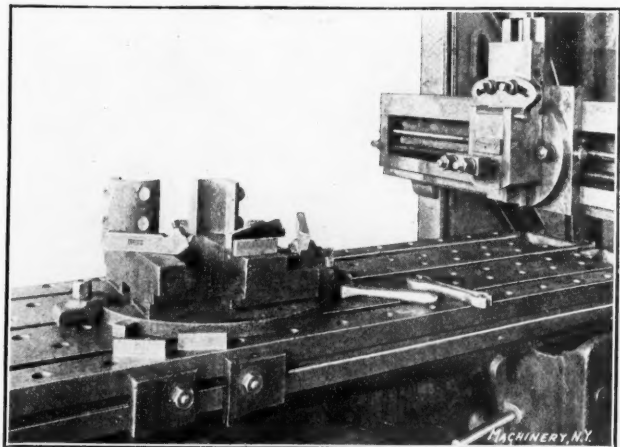


Fig. 2. Planer Chuck Used for Holding the Caps.

HOWARD P. FAIRFIELD was born at Patten, Me., in 1868. He served an apprenticeship with the S. A. Woods Machine Co., Boston, Mass., and has worked for the Boston & Albany Railroad, and the Goodyear Shoe Machine Co. Some years ago Mr. Fairfield left the commercial machine shop and became a teacher in the Case School of Applied Science, Cleveland, O., where he remained for eight years teaching wood-working, pattern-making, machine design, drawing, and machine construction. He left the Case School in 1899, and has since been connected in a similar capacity with the Worcester Polytechnic Institute, Worcester, Mass.

of the string usually spoils all. In so far as the cutting operations on the planer go, they are usually simple in their character, and should be easily mastered. As already hinted at, it is the ability of the workman as regards fastening, or holding his work, that counts.

In the half-tones herewith are shown the planer operations as performed upon a simple machine part—a cap box. No special methods for holding are shown, as all the fastenings used for holding this piece are those in common use for many other pieces, distinctly different in their outlines. Fig.

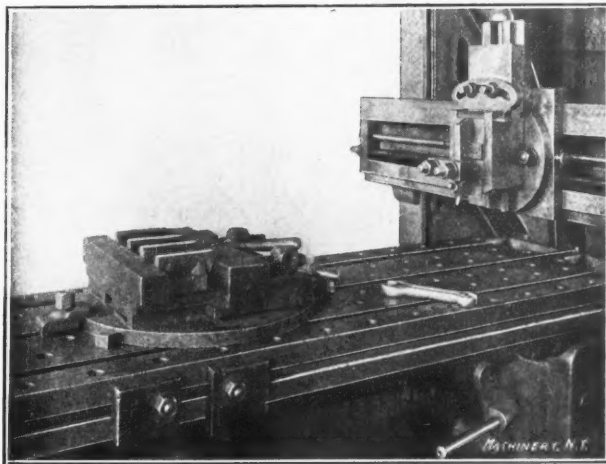


Fig. 3. Two Caps in Place in the Chuck.

1 shows a group of the pieces, planed, drilled, tapped, counterbored and fastened together with four flister head machine screws each, but only the planing operations are shown here.

An essential part of any planer outfit is a chuck for holding small pieces, and this is shown in Fig. 2. This figure shows also the tools used to rough cut and smooth plane the caps, seen standing at the top of the planer jaws. In Fig. 3 it will be noted that the chuck is held to prevent sliding along the length of the planer by two pins which fit holes in the table.

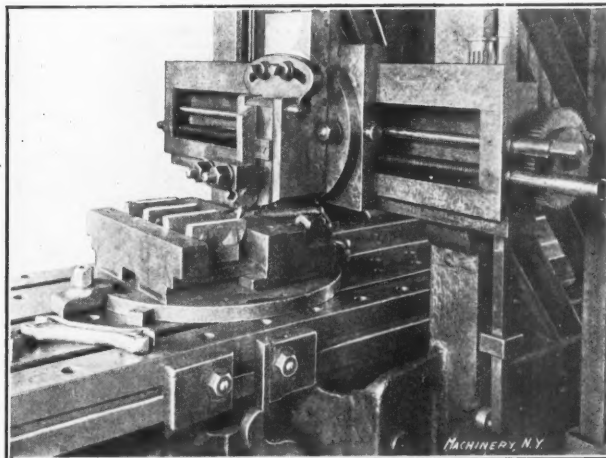


Fig. 4. The Tool in Position Ready for the Roughing Cut.

These are termed planer stops, and are used ahead of all work to prevent slipping due to the thrust of cutting. The work in this case is leveled by using short parallel pieces under the projecting ears on the cap. One jaw of the chuck is a fixed part of the base, while the other is made adjustable upon slides, and can be forced against the work by means of the screws shown at the right of the chuck base. If the pieces tend to elevate when the adjustable jaw is forced against them, light blows with a hammer will seat them again. Fig. 4 shows the tool in position, and the trips set ready to start the roughing cut, and Figs. 5 and 6 show the feed gear in place and the cut being made. The finishing tool used and its method of use is shown in Fig. 7. The tool is about one inch wide, and is fed a distance equal to two-thirds its width each stroke. In this case the feeding is by hand, the feed gear showing slipped out of mesh.

The base portion of the brackets lends itself very handily

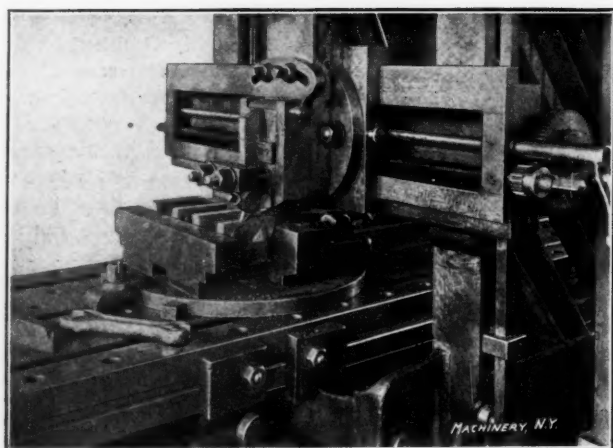


Fig. 5. The Feed Gear in Place.

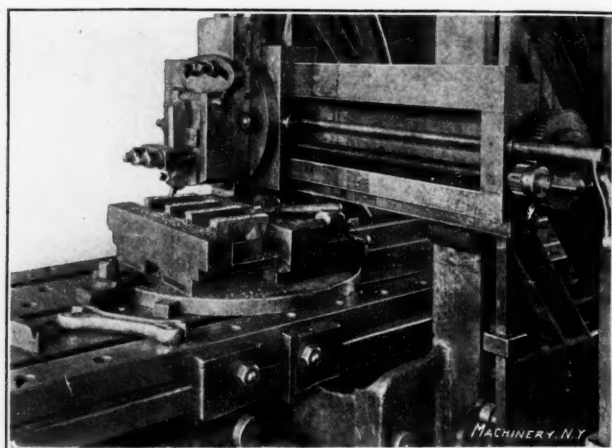


Fig. 6. Rough Planing the Caps.

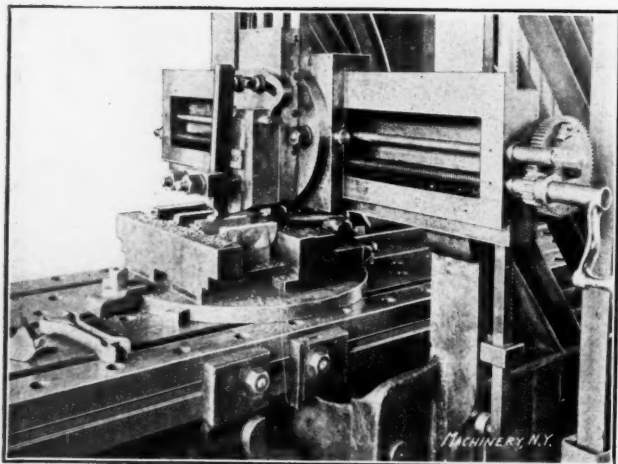


Fig. 7. Taking the Finishing Chip.

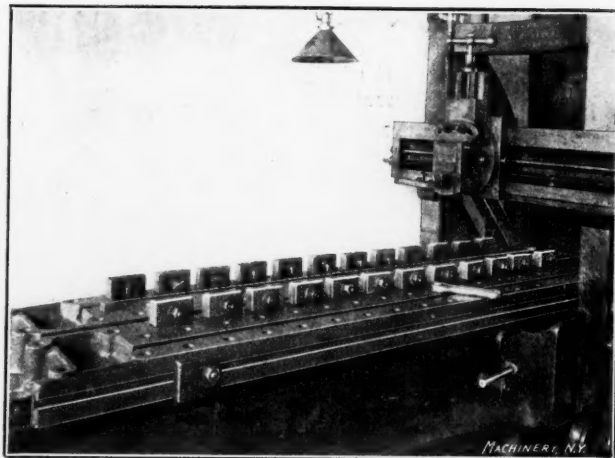


Fig. 8. Straps Used for Holding the Brackets.

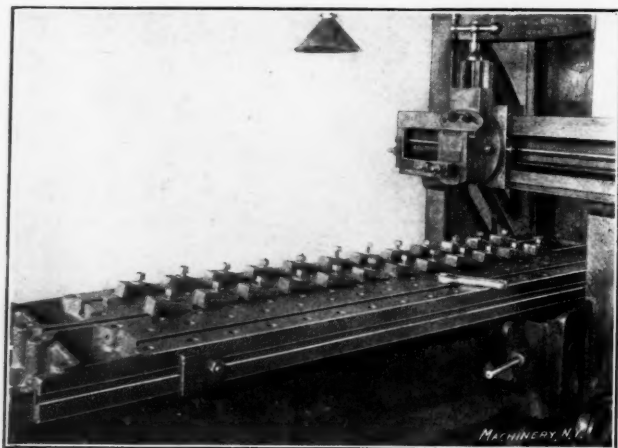


Fig. 9. Straps and Bolts in Position to Hold the Work.

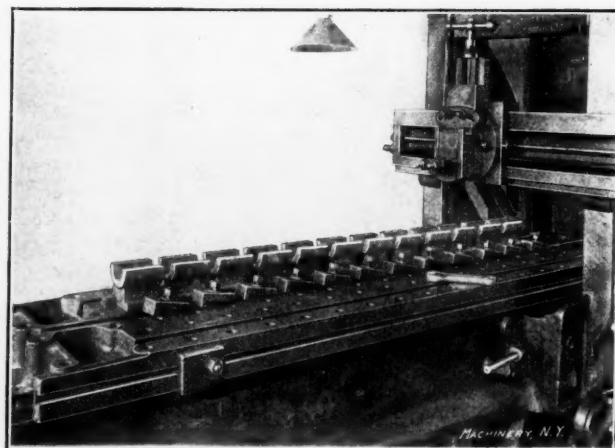


Fig. 10. A String of Brackets ready for Clamping.

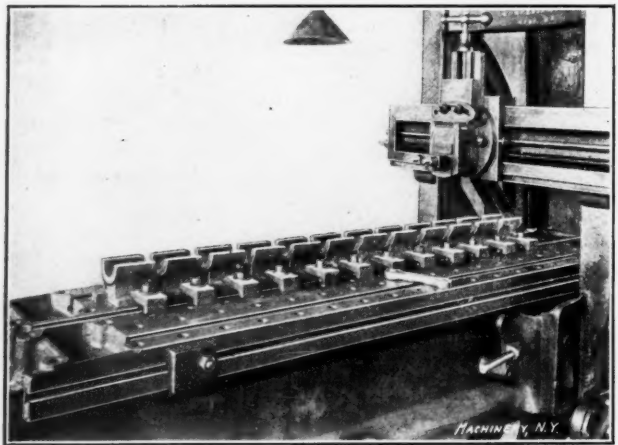


Fig. 11. The Work Clamped in Place.

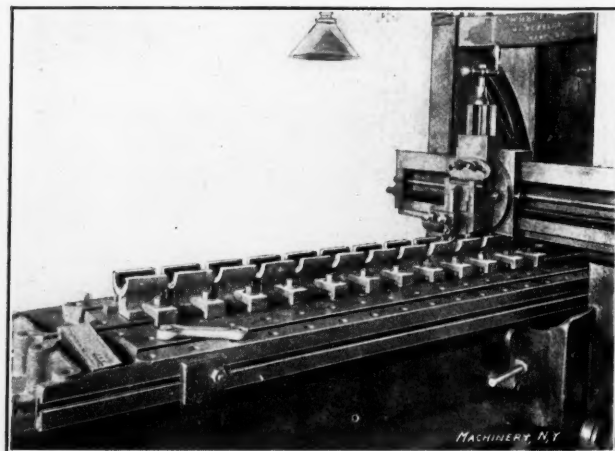


Fig. 12. The Roughing Tool ready for Action.

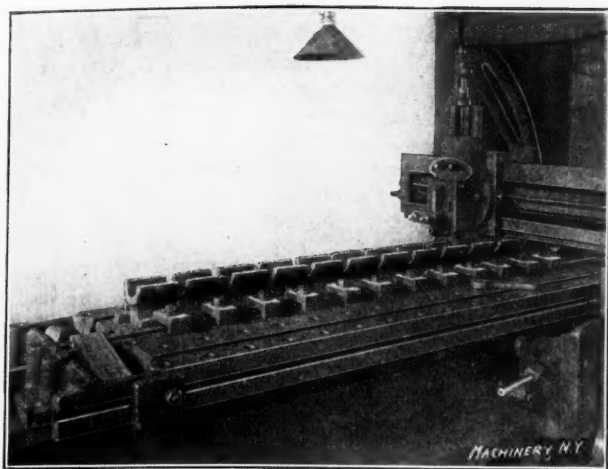


Fig. 13. Completing the Roughing Cut.

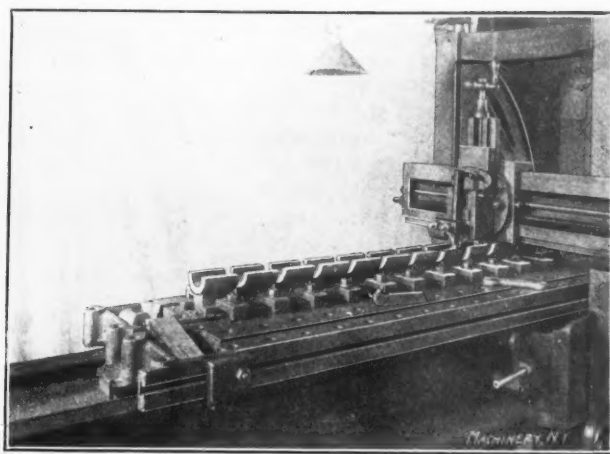


Fig. 14. The Finishing Tool in Place.

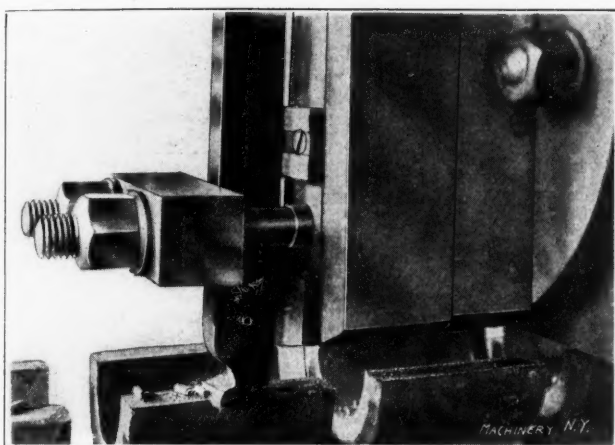


Fig. 15. Taking the Finishing Cut.

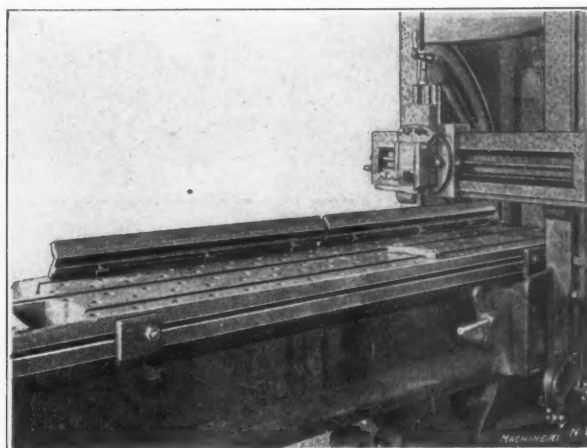


Fig. 16. Back Stops Used for Holding the Brackets Bottom up.

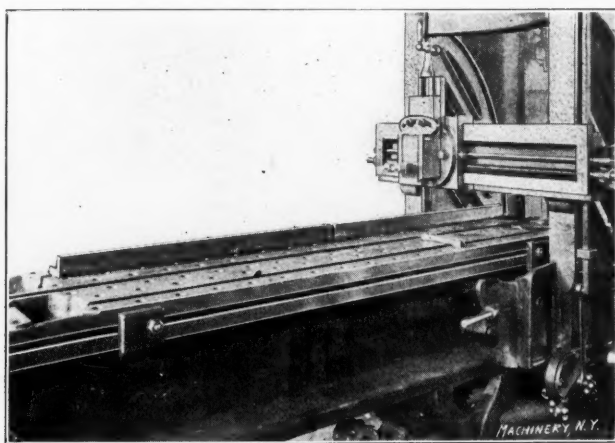


Fig. 17. The Back Stops Clamped in Place.

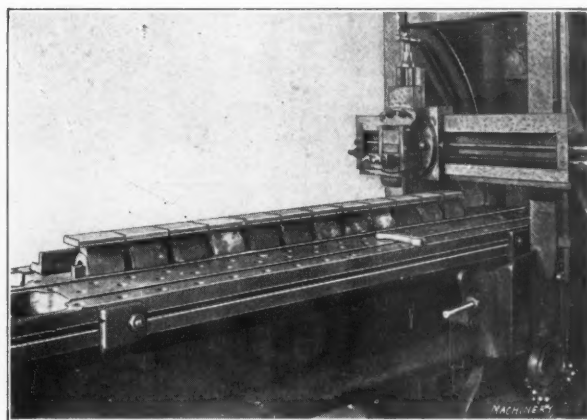


Fig. 18. The Work Lined up against the Stops.

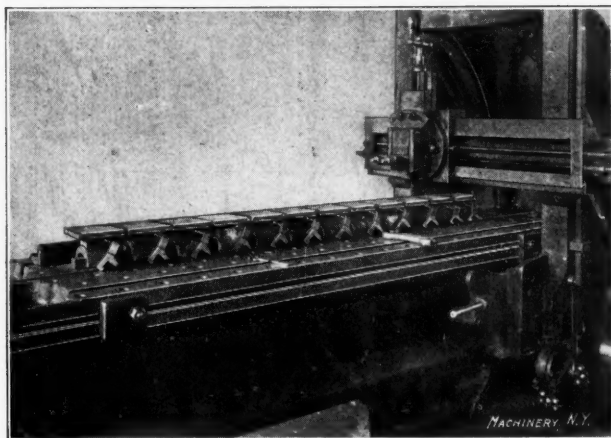


Fig. 19. Ready for Clamping.

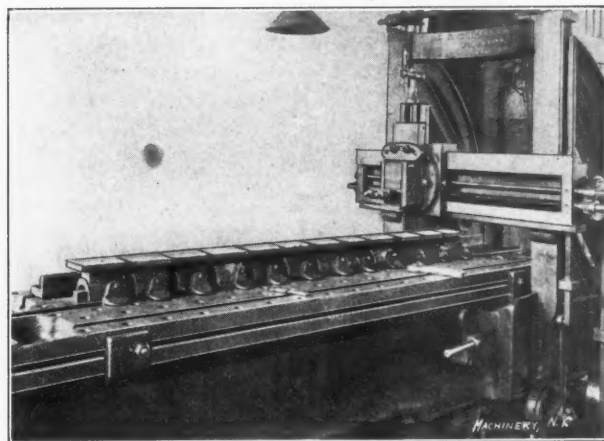


Fig. 20. Ready for the Tool.

to stringing, and Figs. 8 and 9 show the straps and bolts used to bind them to the planer table. In Figs. 10 and 11 the pieces are shown mounted in position, and strapped to the table. Fig. 12 shows tool set to take the roughing cut, and Fig. 13 the cut being taken. Note the stop against which the foremost piece butts to prevent slipping under the thrust of the cutting tools. The final cut is taken with the finishing tool, as in the case of the caps, and is shown in Fig. 14. Fig. 15 illustrates the finishing tool and its use, also the fact that

Use is again made of the finishing tool, as shown in Fig. 23. Fig. 24 is an end view to illustrate the surface as left by the finishing tool. Fig. 25 shows its use at close range and Fig. 26 the under surface of a bracket as it comes from this tool.

* * *

The 12-inch guns on board the *Dreadnaught* will be the most powerful ever carried by a warship. Altogether they will cost something like £113,200 (\$550,152). The salient

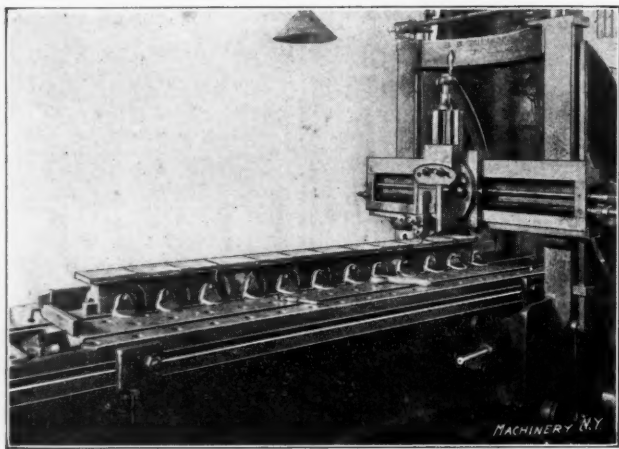


Fig. 21. Ready for the Roughing Cut.

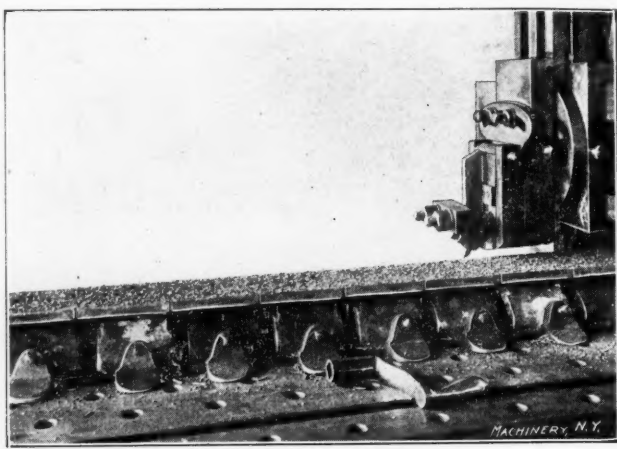


Fig. 22. The Roughing Cut Completed.

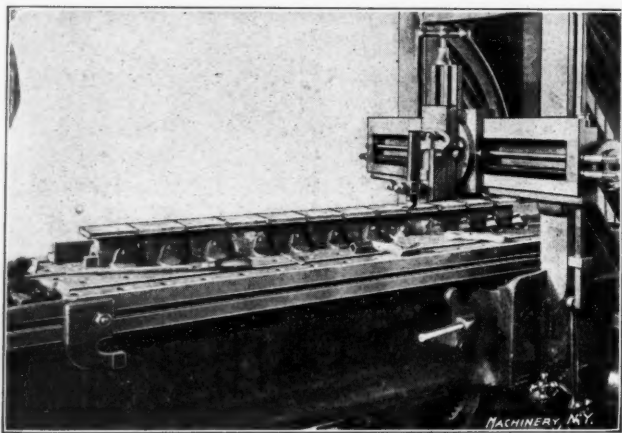


Fig. 23. Finishing the Base of the Brackets.

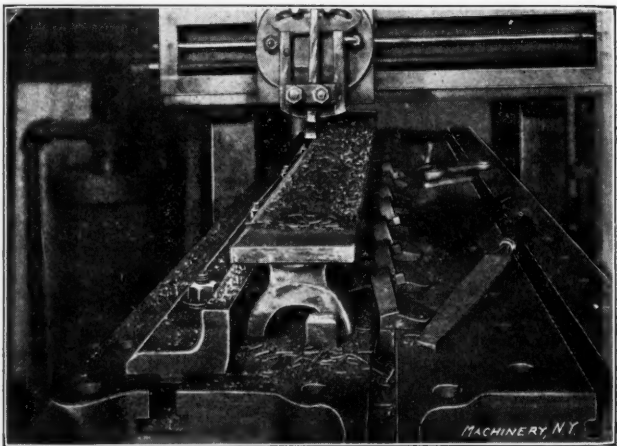


Fig. 24. The Finishing Cut Completed.

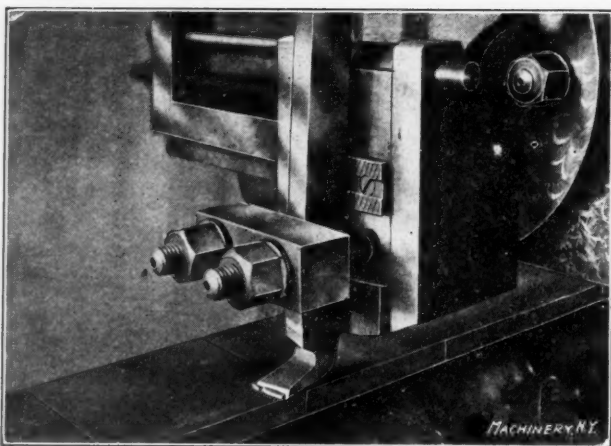


Fig. 25. Nature of the Finishing Chip.

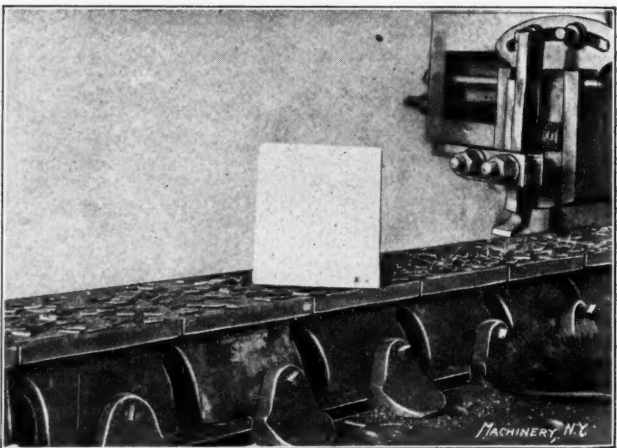


Fig. 26. The Finished Surface.

it is *not* a scraping tool. In planing the reverse surfaces of the brackets, use is made of two back stops. Fig. 16 shows their form, and Fig. 17 their position on the planer table. The pieces are strung as shown in Fig. 18 butted against the pin stop. To hold them down the back stop is beveled back at its base (see Fig. 24), and the pieces are forced against it and down to the planer table by hook stops as shown in Figs. 19 and 20. The roughing tool is set as in Fig. 21, and does its work as shown in Fig. 22.

features of these guns are: Weight of gun, 58 tons; weight of shot, 850 pounds; weight of cordite charge, 325 pounds; shots leave muzzle at 2,900 feet per second; able to pierce at muzzle 51 inches of wrought iron. There are to be 10 of these, and each can fire two rounds a minute.—*Mechanical Engineer*.

[The muzzle striking energy, calculated by the formula $E = \frac{1}{2} Mv^2$, is over 110,000,000 foot-pounds, or enough to lift the whole battleship nearly three feet.—EDITOR.]

TRACING, LETTERING AND MOUNTING.—1.

I. G. BAYLEY.

Tracing.



I. G. Bayley.

At the commencement of a drawing-office career only a few tools may be purchased, adding others as they are needed. Be careful to select the best; it will pay in the end.

A straight pen or two—one for black and one for red ink—a spring-bow pen, bow pencil, and dividers, and a half set of instruments comprising six-inch compass with fixed needle-points and interchangeable pen, pencil, and lengthening bar, will suffice. T-squares, triangles, pencils, rubbers, erasers, and pens are usually provided by the office.

Keep to your own instruments, and have a private mark on your triangles, scales and T-square for identification in case they become exchanged.

Small instruments should be put away each night, as in cleaning up the office they are easily lost. A drawer or cupboard with trays or boxes for the various tools is very necessary for the draftsman.

Have a large clean rag duster or brush to wipe the board and T-square occasionally, as the least particle of dust getting into the pen will clog the ink, causing you to make a poor line.

In case the eraser must be used (a thing to avoid as much as possible) rub a little French chalk or soapstone well into the part erased. Keep a little of this prepared chalk by you; it can be procured from any artists' material store.

A piece of rag, cheesecloth or chamois skin hung by a thumb-tack or drawing pin at your side comes in handy for wiping the pens.

A sand-paper pencil sharpener and an oil stone completes the list.

Inks.—Too much cannot be said about the inks used, as I believe to a certain extent a great many bad tracings can be laid to the bad quality of ink used in the various drawing offices visited by the author, in this country and abroad.

Good ink is indispensable, and no one should attempt to make a tracing until he has it. Some offices, to save (?) expense, resort to many ingenious ways of making ink by wholesale. A large bottle with a ground-glass stopper is provided. A quantity of broken ink (which can be purchased by the pound and much cheaper than buying by the stick or cake) is put into the bottle; a quart or so of ammonia is then poured over the ink. The bottle is then put in a warm place, shaken every now and then until the ink is dissolved, or partly so (the latter usually being the case) when it is supposed to be ready for use. This is the cheapest and worst way of making ink. Some drawing offices buy the ink ready mixed, put up in pint or quart bottles. For shop tracings, either of these methods may be resorted to. But for *neat* work it is almost impossible to get along with either; the only way is to mix the ink fresh each morning, washing out the pallet every day. When purchasing the ink sticks, the very best should be bought; it can be recognized by a pleasant odor which cannot be mistaken and is perceptible when grinding it in the saucer. The saucer, or pallet, should be spotlessly clean, and the water clear. Do not use too much water at first; more can be added as the ink is mixed. A little vinegar in the ink will keep away the flies. In many offices in warm climates they are a great nuisance; the writer has seen whole views completely eaten away by these pests in a very short time. Commence by rubbing a little Prussian blue in the saucer; this is not absolutely necessary, but it improves the

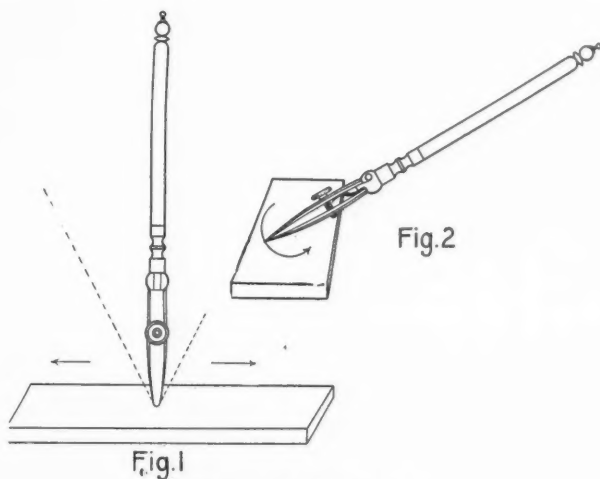
ink somewhat and helps to thicken it quicker. Saucers made of slate with ground-glass covers are the best. The ink stick should be held firmly, but do not bear too hard upon it while grinding, or else when mixed the ink will be gritty. Grind until you cannot see the bottom of the saucer when blowing down upon the ink; this is a good test, and you can also see if the ink looks gritty. Try it on the edge of the tracing cloth or paper to see if it gives a clear black line. The cover should always be kept over the ink to keep it from evaporating and free from dust. In cold weather if the ink should thicken hold it before the fire or heater, when it will run easily and will not clog the pen.

Ordinary scarlet ink is used by some draftsmen for making red lines, although it is much better to use a mixed ink of crimson lake color, adding a little ox-gall to make it run. The prepared ox-gall in tiny jars can be procured from artists' material stores. In the absence of this a little soap rubbed into the color will answer the purpose. Bichromate of potash dissolved in the water before mixing the ink will help to keep away flies if you find they trouble you much.

It sometimes happens that boys are troubled with sweaty hands which mark the tracing as the work proceeds. This can be avoided by putting half a teaspoonful of ammonia in the water they wash their hands in.

Truing Up the Instruments.—As the pens are constantly used they will become blunt, which can be seen by holding them to a strong light and looking down upon the nibs. Every draftsman should be able to set his own instruments. There should be an oil-stone in every office for this purpose. Let it lie flat on the window sill or a table near to the light. Screw up the nibs tight, and holding the pen in an upright position between the finger and thumb, as shown in Fig. 1, move it backward and forward along the stone as indicated by the arrows, tilting it from side to side as shown by the dotted lines.

In this way a round and even surface is given to the nibs. They will be of the same length and true with each other. Now, holding the pen in a slanting position of about 30 degrees, rub the nibs upon the stone in a circular direction, as



Truing the Point of the Pen.

indicated in Fig. 2, rolling the pen as it were between the thumb and finger, turning it over and grinding both nibs alike. Hold the pen to the light occasionally to see if the nibs are level, and look down upon the points to see if the flat surfaces have been taken out. If sharpened correctly you will be able to see nothing, as when looking down upon the edge of a razor.

The thumbscrew must now be taken out and the inside edge of the pen be rubbed across the oil stone several times. Thoroughly clean the pen from any grit or oil and try it upon the edge of the tracing. If too sharp, it will have a tendency to run away from the T-square or straightedge, in which case it should be rubbed on the stone again, as in Fig. 1, though with care, as all pens should be fairly sharp.

The bow pen is trued up in the same way, with the exception that a thin slip of stone is passed between the nibs to take off any rough parts, as the nibs of the bow pen do not

I. G. BAYLEY was born in Ocker Hill, Tipton, Staffordshire, England, 1866. His education, outside of the common school, has been derived from home study and reading and courses with correspondence schools. He was apprenticed in the drawing rooms of the Old Park Iron Works, Wednesbury, Staffordshire, England. In addition to this company, he has worked for the King Bridge Co. and Globe Iron Works, Cleveland, Ohio, and Frank C. Roberts & Co., Philadelphia, Pa., in the positions of tracer, draftsman, checker, assistant head draftsman and designer. His specialty is mechanical drafting and designing.

hinge and some straight pens, too, for that matter, when they should also be treated in the same manner.

All instruments should have the best of care. When not in use for some time they should be kept clean and free from rust by wiping them on a piece of chamois leather greased with vaseline.

Tracing Paper.—Tracing paper is much used in architects' offices and occasionally by engineers for pencil sketching. When it is used for permanent work, the best quality should be had. But although it is possible to purchase paper capable of standing fairly rough usage, it is by no means as good as cloth.

A narrow strip of tracing cloth tacked along the lower edge protects it from being torn or soiled while leaning over the board. Either thumb tacks (drawing pins) or very small tacks may be used to hold down the paper; a small magnetized hammer can be used for the latter, picking the tacks up very quickly, so that which ever plan is adopted it takes about the same time.

In case the tracing will last for some time, or if there is any coloring to be done, the paper must be mounted on the board as described elsewhere.

Tracing Cloth.—For permanent work tracing cloth should by all means be used. Cloth is either glazed or unglazed, the foreign make being by far the best. With proper care a tracing may be taken up when complete, as clean as when cut from the roll. All shop or working tracings should be made on the unglazed or dull side of the cloth, as this side will take

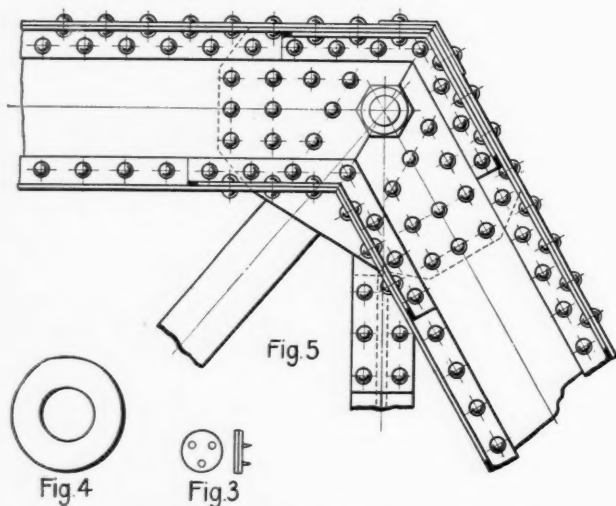


Fig. 3. Horn Center, Figs. 4 and 5, Examples of Shading.

pencil lines nicely, and when erasing has to be done it will not mar the surface so perceptibly. But for show or estimate tracings where much finer and neater work is required, the glazed side must be used. The lines will be sharper and the work will stand out much better. In either case the cloth should be laid down in the same manner as the paper. It should then be rubbed down with pulverized chalk.

Laying Down the Tracing.—The drawing to be traced is squared up with the board and wiped down with a dry cloth or duster. The roll of tracing cloth is run down the board and cut off to correct size. The edges at either side are then torn off quickly and the cloth laid down correct side up. A tack is put in the center of the top edge; the flat of the hand is drawn firmly but gently down to an opposite point at the lower edge, the fingers spread apart, while another tack driven between them holds that edge. Run the flat of the hand gently to the one side, driving in a tack; then to the opposite, stretching it well and securing it by another tack. The four corners and all intermediate spaces are then held down in the same manner.

With a dry rag or piece of chamois skin rub some pulverized chalk (or chalk scraped from the stick) all over the tracing cloth, dusting it off with a dry rag or brush. This will cause the pen to bite much better, especially in the case of show tracings where the glazed side is used. Some draftsmen use a little ox-gall in their ink for this purpose, but unless the exact quantity is used the ink will be very sensitive.

Tracing.—Everything is now ready for tracing. Try to understand the work as you proceed. If the job is likely to last long, work on one view and complete it, as sometimes the temperature of a room will change over night, causing the cloth to become quite flabby, and although it may be stretched again by holding it near the radiator or in the sun, yet it very seldom goes back to its correct position. But when making a smaller tracing which can be completed in a day, put in all the black lines first, the red or blue lines next (when making show tracings), the printing or lettering next, and finally the border and cutting-off lines.

Although as a rule red and blue lines are put in last, yet there are a few exceptions, as, for instance, when tracing a number of bolt or rivet heads in bridge or girder work; if a red line is run right through the heads, it will be easier to get them all exactly true and in line; otherwise they are apt to be put in in a very zig-zag way.

If the drawing is crowded the best plan is to stick to the rule and put red lines in last, as otherwise they will make the drawing hard to read by covering up work not yet traced. As a general rule, commence with the circles and curves first, joining the straight lines onto the curves, and not *vice versa*. When a number of circles and curves are struck from the same center, always commence with the smallest or inner one first while the center is good.

Sometimes a horn center, shown in Fig. 3, is used to protect centers from which a number of curves or circles are struck, as gear wheels, for instance. These horn centers are circular pieces of horn with three needle points. Some draftsmen glue a small piece of hard wood or horn over the centers. The pens should be tried upon the edge of the tracing to see what thickness of line they make, and when once set they should not be moved; for this reason some pens have small lock nuts on the thumbscrews. They should be wiped and the ink put in without again adjusting the screw. This particularly applies when making heavy lines. In this way all lines will be of the proper thickness. The pens can be filled with an ordinary writing pen or dipped in the ink sideways.

Working Tracings.—Working tracings or shop tracings are usually made a little heavier than others. The lines should be all the same thickness. No red or blue lines need be used, but all black, and although the tracings should be neat, especial care being given to the figures and dimension lines, yet such care need not be taken as when making a show or estimate tracing. The figures should be plain and simple and might be made a little large. The arrow points should be true and go exactly to their intended position. The figures should be checked before handing in the tracing so that as few mistakes as possible will come back to the tracer.

Show Tracings.—Estimate or show tracings should have a little more time expended upon them. The lines need not be so heavy and as a general rule are shaded, *i.e.*, the lines furthest from the light, which is supposed to come from the top left-hand corner, should be heavier than the others; this is clearly shown in Fig. 5. Shade lines can be made by going over the lines again or adjusting the screw of the pen, causing the ink to make a heavier line. When dark-lining a circle the radius is kept, but the center changed slightly, as shown in Fig. 4; or the same center and radius may be kept, going over the dark or shaded side several times with the pen.

The letters, figures and dimension lines should be made neatly, the arrow points evenly made. Some draftsmen put in the arrow heads with their spring bow pen, and since they can be put in just as quickly this way and look much neater it would be well to practice this method.

Dotted lines should be finer than full ones. The dots and spaces should be the same length—about one-thirty-second to one-sixteenth inch in length.

In shading rivet heads sometimes a small half circle is made inside the first, as shown in Fig. 5. It should be heavier than the outline of the rivet head.

The heading or title should be neat and attractive and a fancy border line might be made. All notes or stray words should have a neat red line drawn under them. Bolt heads should be neatly made and all small work neatly executed. Threads of bolts should be parallel and equally spaced, and

may be accurately drawn or indicated, as shown in Fig. 6, *c*, *d* and *e*. Dotted work can be shown to advantage if the dots forming the apex and root of the threads are united, as shown at *e*. These may seem trifles, but they all tend to make a neat tracing.

Holding the Instruments.—The author has been more than surprised at the rough and unsteady way which some drafts-

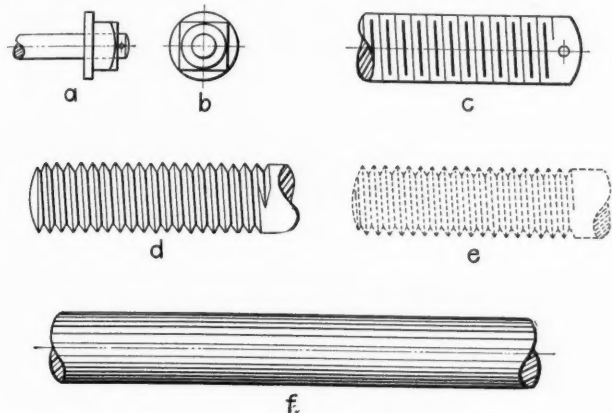


Fig. 6. Screw Threads and Shading.

men have of holding their instruments. The bow pen should be held lightly at the top between the thumb and first two fingers, resting the little finger upon the tracings to steady the instrument while finding the position for the point. This being found, the little finger should be lifted and the bow pen cleverly spun between the thumb and first finger. It is good practice at your leisure to see how quickly you can make a number of small circles; in this way you will get into the knack of cleverly spinning the bow pen as described, instead of holding it in an awkward manner.

The straight pen should be held in a slightly inclined position, the thumb-screw on that side away from the T-square or straightedge and with the second finger resting upon the screw to adjust if necessary.

* * *

The steps which have been taken by the Japanese government for the nationalization of its railways, and the recent developments in the industrial and commercial situation in Manchuria, indicate that that nation has determined on a definite policy of government control of commerce and manufacturing. Consul-General Miller in a recent report from Yokohama says:

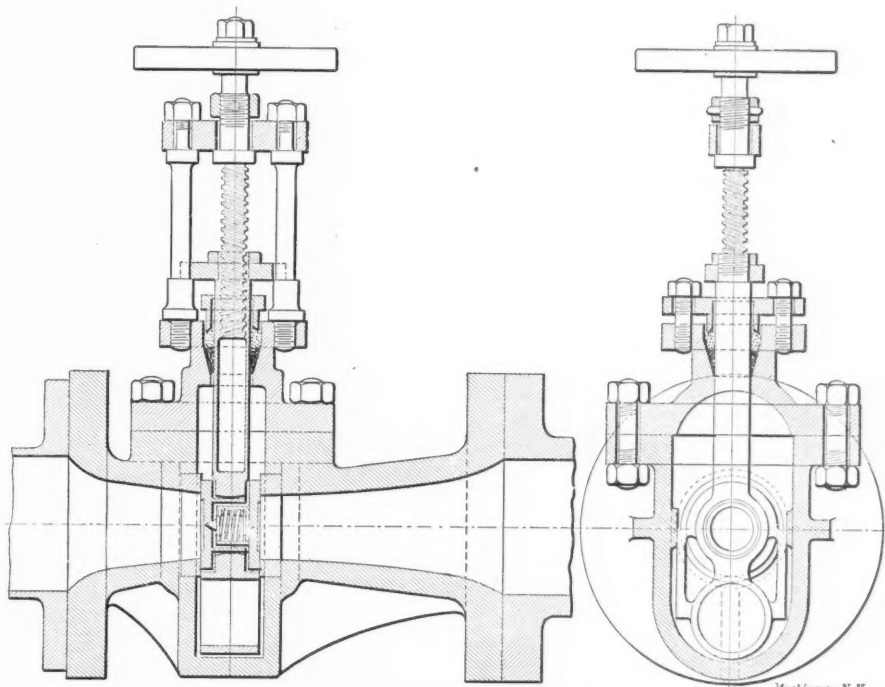
"She is undertaking one of the greatest experiments in the world's history in the relations between government and industry. If successful along the lines she is now working on, the individuals and corporations of America that are striving for the trade of the Orient will discover that they are not competing for this trade against individuals and corporations of Japan, but that they are in commercial conflict with the Japanese nation. I am convinced that this is the condition to which American manufacturers and merchants must look forward and be prepared to meet.

"The financial world seems now to be in keen competition to provide Japan with money for almost every purpose, and the lack of wealth is not likely to retard her industrial and commercial expansion. In viewing this great Japanese experiment of nationalization of industries it is not wise to prejudge it, and assume it will be a failure because it would fail in European or American countries. A thorough knowledge of Japanese history and character will cause any thoughtful person to hesitate before pronouncing it impracticable."

THE HOPKINSON-FERRANTI STEAM VALVE.*

The manufacture of stop-valves has now been carried on for so many years that one might well have thought that finality had been reached. We are, however, indebted to Mr. Ferranti for a radical departure in valve construction, which promises to considerably modify existing practice. The valve works upon the principle of converting the pressure of the fluid to be controlled into velocity, passing it through a comparatively small orifice, in which the working parts of the valve are placed, at a high velocity, and then reconverting the velocity into pressure again by means of a suitably formed nozzle. We give an illustration of the valve, which is being manufactured by the well-known firm of Messrs. J. Hopkinson & Co., Limited, of Huddersfield. From the engraving its construction will be readily understood. The new idea is so simple, and the advantages of the valve are so obvious, that it seems strange that it has not been invented long ago. It must be remembered, however, that accurate knowledge on velocity and pressure conversions of elastic fluids is of quite recent date; and it has only been by a combination of circumstances that the present development has been brought about. As the result of very careful design and a large number of experiments, Mr. Ferranti has produced a valve with very much smaller working parts, through which the drop of pressure, under normal circumstances, is negligible, and which is capable of carrying the heaviest overloads. This valve can therefore advantageously take the place of an ordinary full-bore straight through valve.

As will be seen from the illustration, the steam entry to



Machinery, N. Y.

The Hopkinson-Ferranti Steam Valve.

the valve is formed of a conical nozzle. It has been found advisable in practice to make the throat of this nozzle half the diameter of the pipe in which the valve is placed, and it therefore has one-quarter the area. In this throat the operative parts of the valve are placed. These are made according to Messrs. Hopkinson's well-known construction, the discs and seats being of their "Platnam" metal, which has been found very durable under the most severe conditions. As, however, it is of the utmost importance that the path should be perfectly smooth, so as to avoid as much as possible loss from eddying, the moving part of the valve is of special construction. This will also be seen from the illustration, which shows that the moving parts are so constructed that when the valve is closed the ordinary discs are in position against the faces; and when the valve is opened a smooth tubular passage is brought accurately into line between the cones forming the path through the valve.

*London Engineering, June 29, 1906.

The steam, on leaving the throat, passes through a diverging nozzle and converts its velocity into pressure; and it is the smoothness of the throat and correctness of the whole path which are of such great importance in giving the valve a high efficiency. The nozzles, both leading to and from the throat, have been designed on the basis of equal conversion of energy per unit length of the path, so as to obtain the minimum loss by eddying. Every precaution is taken in the design and manufacture of the valve to ensure the tube which forms the path through the throat being in accurate alignment with the nozzles when the valve is full open. To give an idea of the importance of the smoothness of path in the throat it may be stated that when this special construction is replaced by the parts ordinarily found in a straight-through valve, the drop of pressure at once becomes serious.

The advantages to be obtained by the use of this valve are very important. The new valve, for the same capacity as that of an ordinary straight-through valve, is very much smaller in size, and is of about half its weight. This matter, though not so important on land, is one of very great importance on board ship, where everything possible is done to reduce weight. One of the most serious troubles in large steam installations is that of valve leakage, and in the valve in question it will be seen that with equally good manufacture the leakage must be at most one-half, owing to the periphery over which leakage can occur being half that in the ordinary valve. But, as is well known, the smaller the structure the stiffer it is possible to make it, and it is therefore probable that the leakage will be reduced by a good deal more than half.

Another advantage is that the valve does not require a bypass; as it is found that partly owing to the reduced area of the opening and partly to the conical approach to the opening, the flow of steam is almost directly proportional to the number of turns given to the controlling wheel. There is, therefore, no rush of steam on opening, such as one gets with ordinary valves, and there is a continually increasing and nearly proportional flow right up to the last movement of the handle. This is a matter of considerable importance, as by careless opening of valves a good deal of damage has resulted at different times, from the sudden rush which takes place. Owing to the progressive flow through the present valve this danger is done away with. Moreover, in valves of fair dimensions, such as are now being very generally used, the work of opening and closing is very considerable. The present valve has to be moved against a quarter of the load on account of the reduced area of its working parts, and for only half the stroke of a normal valve, and the work of opening and closing may therefore be put down as approximately one-eighth of that at present required.

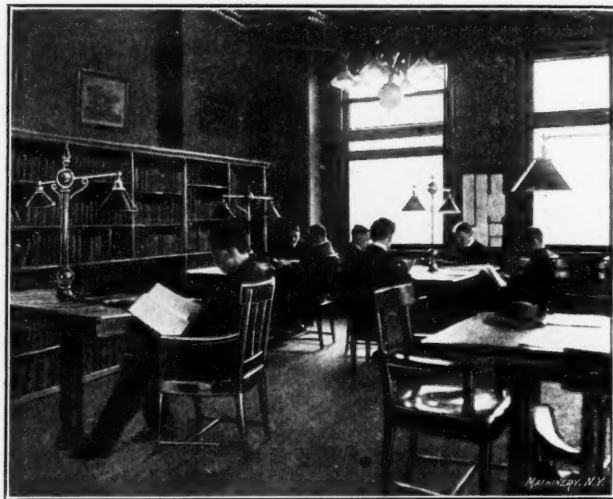
The lagging of steam-pipes for the purpose of saving heat losses is now generally done with very great care; and in steam installations where the engineers are concerned with the good appearance of their pipe-work it is always a very serious difficulty to so lag the valves as not to lose heat, and yet, at the same time, to prevent their spoiling the general appearance of the plant. The new valve, as will be seen from the illustration, lends itself very specially to being well lagged; in fact, the diameter of the lagging required for the pipes is about that which is required for entirely enclosing the hot part of the valves, and thus a neat and workmanlike job can now be made of the covering of a pipe system.

Many engineers will, no doubt, have come across the difficulty and annoyance arising from the fact of their having to provide different flanges upon their steam-pipes where these are jointed to stop-valves, owing to the welded-on flanges suitable for pipe-lines being too small in diameter, and having bolts at too small a radius for connecting to the cast-iron or cast-steel valve-bodies. This difficulty is entirely overcome in the new valve. It will be seen from the figure that the cones of which the valve is formed enable the bolts to be put close enough in to the center to allow of standard pipe-line welded-on flange being used. The importance with the new valve of being able to keep standard pipe-line flanges throughout the pipe system is very great, and will be much appreciated by engineers.

APPLIED SCIENCE REFERENCE ROOM OF THE PRATT INSTITUTE LIBRARY.

Most of us have been discouraged at one time or another in hunting for information on scientific subjects in the public libraries with which our country abounds. It is often exceedingly difficult to make practical use of them in obtaining information on mechanical engineering, for instance. This is due in many cases to the poor selection of books on this and kindred subjects. Many of the works are old and out of date, while the newer ones will very likely be found to belong to that large class which either gives no useful information, or else has it arranged in such form that it is unavailable for practical use. In contrast with this common condition it is with pleasure that we call attention to the efforts that are being made by those in charge of the Pratt Institute Free Library of Brooklyn, to make their applied science reference room of the greatest possible value to the community in which it is located.

Unlike most other large cities Brooklyn is not served by a large central library with sub-stations in outlying districts, but is instead supplied with a number of smaller and practically independent ones located in different sections of the city. Among these the Pratt Institute Library, although in reality a private institution, supplies the needs of a large residential and manufacturing district. It is therefore provided with a full collection of works on history, art, criticism,



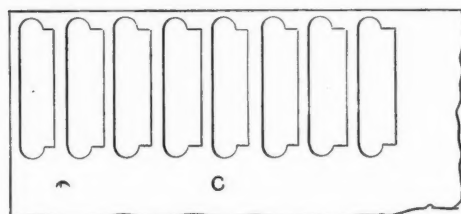
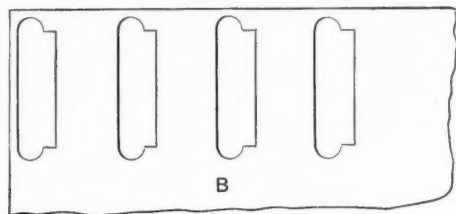
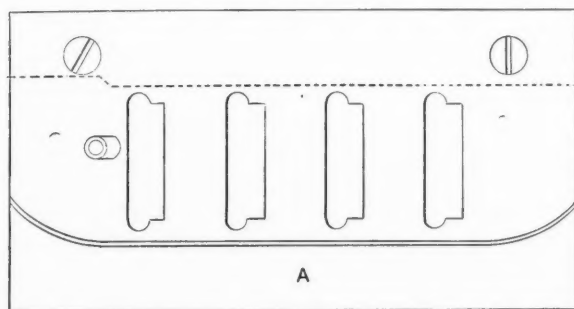
A Corner of the Applied Science Reference Room.

poetry, biography, fiction, etc., as well as with such special books as are needed for the scholars and teachers of the school of which it is a part. It is only with the equipment of the applied science room, however, that we are concerned. This is located on the main floor of the building and is open every day, except Sunday, from 12:30 to 9:30 P. M. and can be used between 9 A. M. and 12:30 through the library office. Over one hundred trade and scientific papers are subscribed to, besides about fifty labor union papers, the most important of the trade journals being bound and preserved for reference. The transactions of all leading scientific societies of England and America are also to be found on the shelves, and a full set of patent office reports is available. The cases on the side walls contain classified selections of books dealing with applied chemistry, metallurgy, mechanical and electrical engineering, building trades, and allied subjects. The half-tone will give an idea of the arrangement and appearance of the room.

The point to which special attention should be called, however, relates to the active effort made by Mr. Edwin M. Jenks, who is in charge of this department, to make it as useful as possible to those who may be helped by it. A liberal appropriation is made yearly for the purchase of new books, and this is expended, as far as possible, on the recommendation of practical men interested in the various subjects with which the collection of books is concerned. A careful lookout is kept for the scientific books in the circulating department of the library which are most often taken for reference, and such

books are either placed in the reference room or, if the circulating demand is also large, a new copy is bought.

Furthermore, Mr. Jenks has been making a survey of his district to locate the position and nature of the various industries represented there. From this information an industrial map is being prepared which is expected to be of considerable service. Visits are made to manufacturing establishments from time to time, when the library is brought to the attention of the different manufacturers, and permission is asked to post notices about the plant and to distribute cards calling attention to the equipment of the reference room. In addition to this, classified lists of the available books concerned with the various industries are being prepared by men who are familiar with the practical conditions involved. These lists give not only the name of the book and that of its writer, but describe in a few words the nature of its contents and the manner in which the subject is treated, thus saving much trouble on the part of the user. Of these lists, the catalogue of books on electricity has been completed. Another innovation is the collection of mounted cuts which have been clipped from various books and periodicals and indexed in such a way as to be available for reference. This includes a great variety of pictures of machines and mechanical de-



Machinery, N.Y.

Fig. 40. Arrangement of a Multiple Die.

vices which may be used in the room or taken away if desired. A man desiring to get ideas in the line of chucks, for instance, would find a large collection of illustrations here from which he might get helpful suggestions.

In general those responsible for this reading room appear to have their ears to the ground, if the expression may be used, and give evidence of being sincerely desirous of making it a useful institution. With these intentions so plainly evinced it would seem to be the fault of the user of the library if it did not prove to be of service to him in his work. This example is commended to the attention of other similar institutions.

[Since the above was written, we have received the catalogue of books therein mentioned. The pamphlet is entitled, "Books on Electricity, an Annotated List." It measures $4\frac{1}{2} \times 7$ inches, and describes some three hundred works. These are classified in a way which is convenient for reference. Any one to whom this list would be useful may obtain a copy by addressing a request to the Pratt Institute Free Library, Brooklyn, New York.]

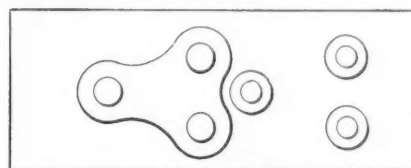
PUNCH AND DIE WORK.—3.

E. R. MARKHAM.

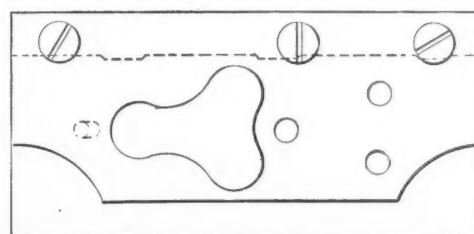
Multiple Dies.

The reduction of the cost of manufacture is often possible by the use of multiple dies, whereby two or more pieces are punched out at a time. In punching perforated steel work it is no uncommon thing to see punches and dies in use where several hundred punches are working into one die.

If an article, for example, of the form shown in the die in Fig. 40, were to be punched in lots of several thousand, the die should punch a number at a stroke. Such a die and the



PLAN OF PUNCH



PLAN OF DIE

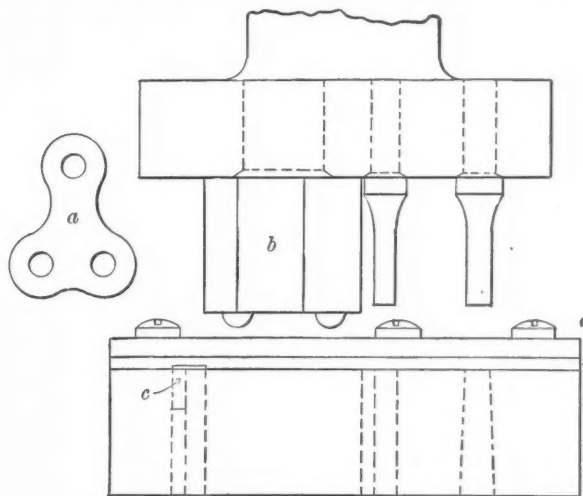
Machinery, N.Y.

Figs. 41 and 42. A Gang Punch and Die.

stock left are shown in Fig. 40, where the die is shown at A and the stock after the first punching at B. It will be noticed that the distance between the openings is considerable. This is necessary, as it would not be possible to place the openings in the die as close as they should be to economize stock, since there would not be stock enough between to insure the die sufficient strength to stand up when working. For this reason the openings are located as shown. After punching as shown at B, the stock is moved along the right distance so the intervening stock can be punched out, as at C.

Gang Dies.

If it were desirable to punch a piece like that at a in Fig. 43, it would be possible to make a blanking die and punch



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Fig. 43. Elevation of Gang Punch and Die.

which would produce the blank of the right size and shape, but without the holes; then, by means of another die, with three punches working into it, we could punch the holes. It is apparent that such a method would be more expensive than one that made it possible to punch the holes and the piece at one passage of the stock across the die. This may be done by the use of a die of the description shown in Figs. 42 and 43. When using this die the stock is placed against the guide and just far enough to the left so the large punch b will trim the end. Then, when placed against the stop or gage pin c,

bring the guide pins in end of punch *a* in line with the holes punched at the first stroke of the press at the time the end was trimmed.

When the stock is purchased of the proper width for one piece, it is fed through and the scrap thrown aside. At times it is purchased just wide enough for two pieces, in which case one edge is placed against the guide *d* and the stock fed through; after which it is turned over and fed through with the opposite edge against the guide, thus using all the stock except such portion as went into scrap.

However, if the stock is purchased in the commercial sheet, it is necessary to trim the edges every time a row is punched along each. If no power shears are located handy to the press this may prove to be a more costly operation than the punching, and no matter how conveniently such a shear may be located, the operation adds a considerable cost to the product. To avoid this trouble and expense another punch and opening to the die may be added. The object of this punch is to remove the scrap between the openings in the sheet and also trim the edge of the sheet, thus making it straight and in condition to bear against the guide on the die. The die and punch with the addition mentioned are shown in Fig. 44.

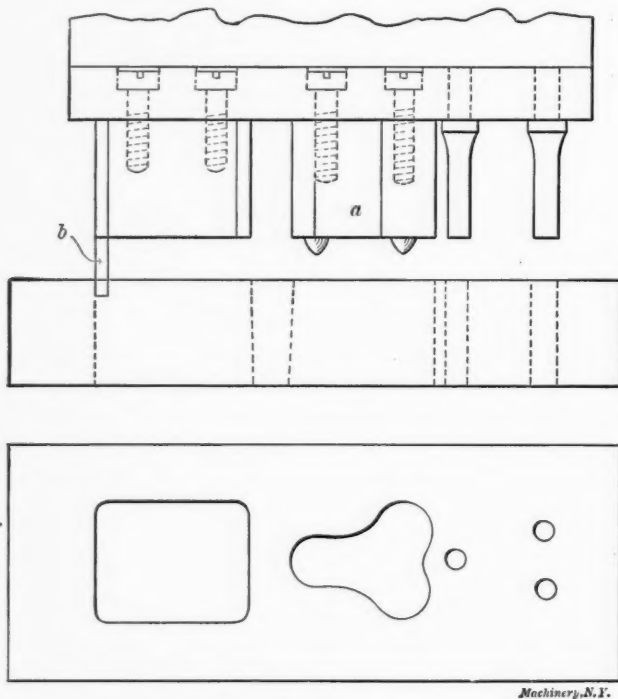


Fig. 44. Gang Punch arranged to use Sheet Stock.

When using a trimming punch as described above, it is necessary to use a stop of the description shown at *b*. The end of the scrap striking this governs the location of the stock, and when the punch descends the scrap is cut away.

When making dies of this class it is necessary to have the blanking die *a* the longer in order that the locating pins on the end may engage in the holes in the stock and locate it right before the other punches reach the stock. It is also necessary to place the stop, or gage pin, so the stock will go a trifle further than its proper location—say 1-100 inch. Then when the locating pins engage with the holes they draw the stock back to its proper location; whereas if the tool maker attempted to locate the stop exactly any dirt or other foreign substance getting between the end of the scrap and the stop would cause trouble.

Bending Dies.

While it is possible, in certain cases, to bend articles during the operation of punching it is usually necessary to make a separate operation of bending. There are instances where bending fixtures which may be held in a bench vise, or attached to the bench, answer the purpose as well and allow the work to be done more cheaply than if bending dies were used. But as a rule the die used in a press provides the more satisfactory method and allows the work to be done at a fraction of the cost.

It is sometimes possible to make the dies so the various

operations can be done in different portions of the same die block, the piece of work being changed from one portion to another in order as the various operations are gone through. At other times it is necessary to make several sets of bending dies, the number depending on the number of operations necessary. When a "batch" of work has been run through the first die it is removed from the press and the next in order placed in, so continuing until the work has been brought to the desired shape.

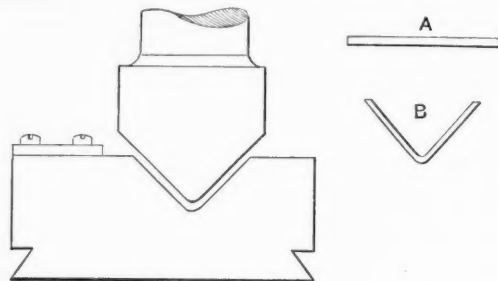


FIG. 45

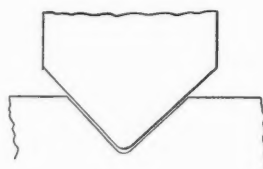


FIG. 46

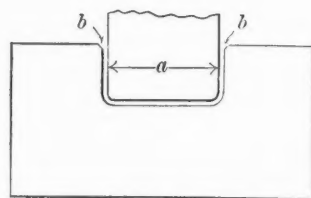


FIG. 47 Machinery, N.Y.

Examples of Bending Dies.

When a comparatively small number of pieces are to be bent to a shape that would require a complicated and consequently costly die in order that the work might be done at one operation, it is sometimes considered advisable to make two dies, which are simple in form and inexpensive to make, to do the work.

At times the design of the press is such that a complicated die could not be used; and as a result additional dies of a simpler form and which can be fitted in the press must be made.

We will first consider the simpler forms of bending dies. Fig. 45 represents a die used in bending a piece of steel *A* to a V-shape, as at *B*. In the case of a die of this form it is necessary to provide an impression of the proper shape as shown; this impression, if the die is to be used for bending stiff stock, must be of a more acute angle than if stock having little tendency to spring back when bent to shape be used. Under ordinary circumstances the upper portion or punch would be made of the same angle as the die. It is necessary to provide guides and stops as shown to locate the work properly.

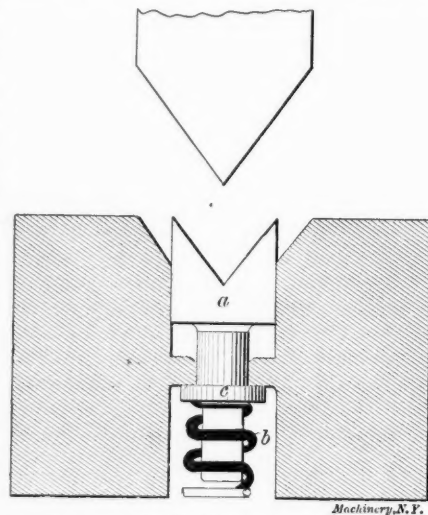


Fig. 48. A Bending Die for Accurate Work.

If the stock used in making the pieces is of a high grade and the product is a spring or similar article which must be hardened, it will be found necessary to cut away the die somewhat in the bottom of the impression, making it a little different in shape from the punch as shown in Fig. 46. This is to prevent crushing or disarranging the grain of the steel to an extent that would cause it to break when in use.

If the die is of the form shown in Fig. 47, it is, of course, necessary to make the length *a* of punch shorter than the distance across the opening of the die. It must be somewhat shorter on each end than the thickness of the stock being

worked. If possible, the upper corners *b b* of the die should be rounded somewhat, as the stock bends so much easier and with less danger of mutilating the surface than when the corners are sharp. When bending thin ductile metal the corners need but little rounding. If the stock is thick, or very stiff, a greater amount of round is needed.

While the form of bending die in Fig. 45 answers for ordinary work, there are jobs where such a die would not insure a degree of accuracy that would answer the purpose, and it will be found necessary to make one similar to Fig. 48, where a riser or pad *a* is provided as shown. This is forced upward by the spring *b* and is gaged as to height by means of the

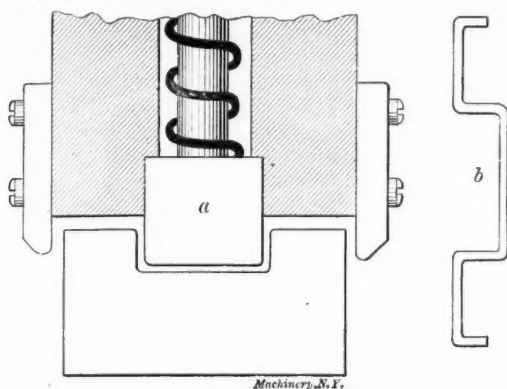


Fig. 49. A Case of Progressive Bending.

washer *c* bearing against the shoulder as shown. It will be observed that the spring gets its bearing against the washer, which in turn bears against the shoulder of the riser as mentioned before.

When making this die the hole is drilled and reamed and the groove milled or planed for the riser, which is put in place sufficiently tight to hold it while the V groove is cut, after which it may be relieved until it works freely.

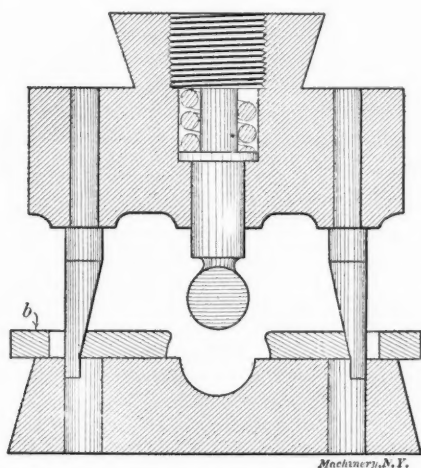


Fig. 50. A Die for Bending Bow Springs.

The spring *b* gets its lower bearing on the die holder. If it is considered advisable a screw may be provided for the spring to rest on. By moving this screw any desired tension may be given the spring, although generally speaking this is not necessary. When bending articles of certain shapes it is necessary to design the tools so that certain portions of the piece will be bent before other portions. Should we attempt to make the tools solid and do the work at one stroke of the press, the piece of stock would be held rigidly at certain points and it would be necessary to stretch the stock in order to make it conform to other portions of the die. In the case of articles made from soft stock, this might be accomplished, but the stock would be thinner and narrower where it stretched. However, as a rule it is not advisable to do this, and dies are constructed to do away with this trouble.

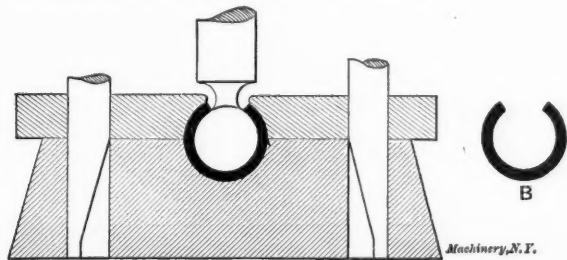


Fig. 51. Action of the Die in Fig. 50.

Fig. 49 represents a die, the upper part of which has the portion *a* so constructed that it engages the stock first, after forcing it down into the impression in the lower portion. Part *a* recedes into the slot provided for it. The coil spring shown is sufficiently strong to overcome the resistance of the stock until it strikes the bottom of impression. The article is shown bent at *b*.



Fig. 52. Successive Loops Formed in a Wire.

Compound bending dies are used very extensively on certain classes of work, especially in making looped wire connections and articles of thin sheet stock.

Fig. 50 shows a die used for bending a bow spring. As the punch descends the stock is bent down into the impression in the lower half and forms the stock to a U-shape. As the end of the punch with the stock comes in contact with the bottom of the impression it is forced into the upper portion, the spring keeping it against the stock while movable slides—side benders—*b b*, are pressed in by means of the wedge-shaped pins so as to force the upper ends of loop against the sides of the punch as shown in Fig. 51, forming the piece as

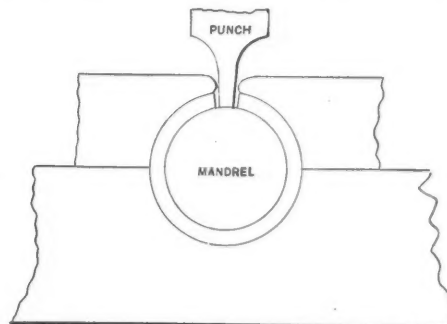


Fig. 53. Forming a Stiff Bow Spring.

at *B*. When the punch ascends, the finished loop may be drawn off. If the stock used is stiff it will be necessary to make the punch somewhat smaller than the finish size of spring, as it will open out somewhat when the pressure is removed.

When making looped wire work, a loop may be formed and the wire moved along against a stop; another loop formed, and so on, as in Fig. 52. When forming looped wire work it is customary to make the punch ball-shaped rather than as shown in Fig. 50. The ball answers as well on wire work and allows of the easy removal of the loop.

It is sometimes desirable to close the upper end of an article nearly together and if the stock used is extremely stiff,

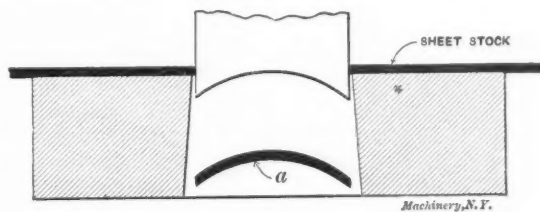


Fig. 54. Punching and Bending at One Operation.

as bow springs made from a grade of tool or spring steel, it may be necessary to heat the bow, which has previously been bent, red hot, and finish bending it by a special process. In the case of articles made from a mild grade of stock this may be accomplished at the time of bending by substituting a mandrel as shown in Fig. 53, for the cylindrical portion of the punch.

A great variety of work may be done by modifications of the forms of bending dies shown. Where but a few pieces are to be bent it is not advisable to go to the expense of costly bending dies; but when the work is done in great numbers they will produce work uniform in shape at a low cost.

Blanking and bending dies are made which not only punch

the article from the commercial sheet, but bend it to the desired shape at the same operation.

As a rule it is advisable to blank the article at one operation and bend it at another, but there are certain forms of work where it is possible to do it in a satisfactory manner at one operation and at a cost not exceeding that of the ordinary blanking operation. This also effects a saving in the cost of tools, as the special bending die is dispensed with.

Fig. 54 represents a punch and die used in punching the shoe *a* to the shape shown, while Fig. 55 is one used for producing the tension washer shown.

Gun and other irregular shaped springs are many times punched to form by this style of die, although when stock suitable for use in making springs is employed it will be

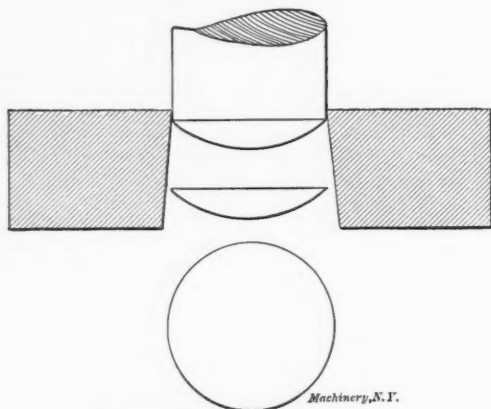


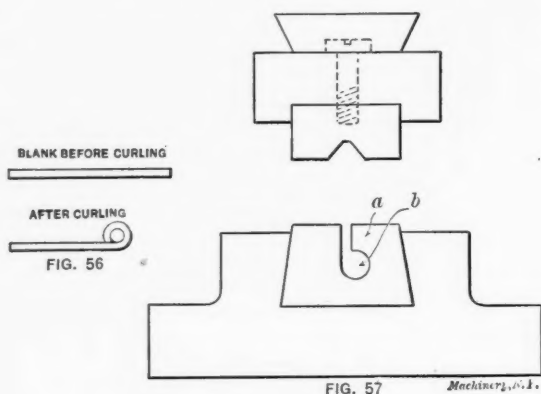
Fig. 55. Making a Tension Washer.

found necessary to make the face of the punch somewhat different in shape from that desired, as the piece will straighten out more or less after it is punched.

If it is desired to curl a form on a piece of work, making a loop as in Fig. 56, it is accomplished by various methods, sometimes by a modification of the die of Fig. 51. A die of the description shown in Fig. 57 is used with excellent results.

In making this die the blank *a* is first machined to size. The hole *b* is drilled and reamed to size and polished to produce very smooth walls. This may be accomplished by using a round revolving lap of the right size. The slot is then milled as shown.

If the die is not intended for permanent use and the stock is comparatively soft or easily bent, it need not be hardened.



A Curling Die and its Work.

If, however, it is to be used right along, it must be hardened. This is best accomplished by pack hardening, being sure that the heats are low. As in the use of this method the die is quenched in oil, there is little or no danger of its going out of shape. Draw to a full straw color.

The punch is made with a V-shaped impression in its face as shown. This may be rounded in the bottom as indicated or left sharp, as desired. If hardened, it may be drawn to a brown color.

It is possible with presses and tools adapted to the work to form pieces to shapes that to one not familiar with this class of work would seem well nigh impossible.

CONCERNING THE VARYING VALUE OF THE DOLLAR.*

Forty years ago, at the close of the Civil War, the United States was doing business with a depreciated paper currency, worth only half and at times even less than half of its face value in gold. While the situation was clearly understood by the financial experts of that day, it was not understood by people in general. Buying and selling, lending and borrowing, went on as if the dollar were an unvarying standard of value, and with no foresight of the impending change. The debtor who borrowed a thousand dollars for a term of years had seldom any idea that he would actually at the end of the term have to pay the creditor in dollars twice as valuable as those he had originally received. The hardships growing out of this change in the value of the dollar were enormous and widespread. They were in large degree responsible for the greenback craze of a decade later and for other financial vagaries which have afflicted us since. No one who clearly understands the situation resulting from the depreciation of paper money in the '60's and '70's can doubt that a currency of fluctuating value is one of the worst evils that can befall a people.

While the financial issue on which public attention was concentrated a few years ago did much to educate the public in the elements of sound finance, there is one fact now pressing on public attention which was rather obscured in the discussion. We refer to the fact that the dollar, even when based on the gold standard, is not by any means an unvarying standard of value. The enormous production of gold during the past twenty years appears to have been one important factor in the depreciation of the dollar which has recently occurred. Theorists have often speculated as to what the result would be if a deposit of gold should be somewhere uncovered from which the metal could be produced in unlimited quantities at a labor cost much below the present value of gold. It is evident enough, of course, that such an event would absolutely reduce the purchasing power of gold everywhere; and to a certain extent, it is claimed, the great production of gold in South Africa, Alaska, and Colorado has tended to produce a similar result.

That a great change in the value of the dollar has occurred is apparent to even the duller observer. The value of money is measured, of course, by what it will procure. Dollars are worthless except as a universally accepted medium of exchange. If a dollar to-day will buy no more in food, clothing, shelter, personal service or other commodities than half a dollar would procure half a century ago, then it is a fair conclusion that the value of the dollar has diminished by one-half. One has but to refer to records of the first half century, showing prices paid and cost of living in those days, to be absolutely convinced that a great change has taken place in the value of the dollar in that period. We do not, however, need to go so far back by any means. In the current number of *Moody's Magazine*, a writer compares the average commodity prices in 1897, at the end of a long period of financial depression, and those of the current year. According to these figures, as compiled by R. G. Dun & Co., there was an average increase in price in that period, nine years, of 47 per cent. That means that it now takes \$1.47 to buy what \$1 would have bought nine years ago.

It is curious to note that this rapid change in the value of the dollar (and the gold dollar, too) has exactly reversed the situation between debtors and creditors that existed in the early '70's. Then the creditor got back from the debtor—if the debtor remained solvent—much more than he originally lent. To-day, if a man loaned money nine years ago at 5 per cent and were now to be paid back the principal with simple interest, he could not purchase as much with the whole as he could with the principal alone when he lent the money. In other words, the shrinkage in the value of the dollar has more than offset all the interest it has earned.

This decline in the value of the dollar must not be confused with another decline which has been going on at the same time, the decline in the rates of interest; yet to a certain extent the two react upon and influence each other. Twenty-

* *Engineering News*, June 28, 1906.

five years ago a hundred dollars loaned would earn six dollars interest every year. Now a hundred dollars loaned will earn only three dollars and a half a year; and that three dollars and a half will only purchase as much as a dollar and seventy-five cents did at that time. The "bloated bondholder," who has so long been held up to scorn, therefore, is now actually receiving from the same principal an income less than a third as great as that which he enjoyed twenty-five years ago.

It has seemed to us that these facts are worth bringing to the attention of engineers. While they may, in a way, be well known, we are all too prone to forget them. We unconsciously think of the dollar as a standard of value; but if it is a standard it is one whose dimensions are varying like a piece of india rubber. We think of wages and salaries as if the dollars could be compared with the dollars paid in wages and salaries twenty years or even ten years ago. It needs but the least thought to see that this is not at all the case. The man, be he president, chief engineer, college professor, surveyor, blacksmith or ordinary laborer, who is paid the same number of dollars per day or per year that he was nine years ago, has actually suffered a reduction in his salary or wages of nearly one-third. He can actually buy only two-thirds of the necessities or comforts of life to-day that he could nine years ago. On the other hand, these changes of values are creating riches on every hand. Those whose property consists in actual things—real estate, railways, ships, mines, stores and what not, have often seen a jump in the value of their holdings which was due only partially to their shrewd business judgment and largely to the fact that the dollar has depreciated in value and thus made their property worth more dollars.

Will there be a return to the lower prices of a former day? So far as the value of the dollar is influenced by the rate of gold production, there is no prospect of any reduction in the output of the world's mines. Rather, with the constant exploration of new countries and the rapid development of chemical and mechanical processes for treating low-grade ores, a steady increase in the world's gold production seems probable, at least for a long period to come. There are, moreover, causes tending toward higher prices for various commodities, such as the growing scarcity of lumber and various metals, or the inability of the sources of supply to keep pace with the expansion of demand. It will be understood, of course, that an increase in price of any important commodity, to whatever market conditions it may be due, operates to decrease the value of the dollar. Inevitably, too, there must be a further readjustment of wages and salaries in many departments to correspond with changed conditions above set forth. All these things tend to make permanent the decreased purchasing power of the dollar and to bring about still further decrease.

[Of direct bearing on the above is the following quotation from a letter recently published in the *Outlook* (London): "There is every reason to believe that prices in the next fifteen years will rise enormously, reverting to the price level of the decade 1867 to 1877. This rise will be unfairly ascribed to the operations of the trusts and to the advance which should equitably take place in railway and steamship rates. The real reason, however, will be the depreciation of gold by reason of its abundance. So recently as 1883 the yield of the mines was only 4,614,588 ounces. For 1905 it was 18,211,419 ounces. If Mr. Bryan in 1896 and bimetalists the world over merely desired inflation they have since got inflation with a vengeance, and inevitably far vaster inflation awaits us."]

* * *

The increasing interest in "industrial betterment" is shown in the work being done in Kinkora, on the Delaware River, 10 miles below Trenton, N. J., where John Roebling's Sons are reported to be expending \$4,000,000 in providing homes for their employees. Expansion of their business led to the erection of new mills near Kinkora, and the consequence was the building of homes for the workmen, including a hotel conducted on the plan of a private club, and a department store. A single man will be enabled to enjoy life for \$2.50 per week and the houses will be rented for from \$8 to \$14 a month.

THE RANSOM CYCLOMETER OR SPEED INDICATOR.

The not unusual conception of the motion of a steam engine flywheel is that of uniformity of angular velocity, varying somewhat, of course, in number of revolutions per minute but not to any great extent within a revolution. This, however, is a mistaken idea as any one knows who has made an analysis of the subject, or has had to do with the operation of even very closely regulated multiple cylinder steam engines driving large alternating current generators, required to work synchronously in pairs or in multiple. The accompanying cut, Fig. 1, shows in diagrammatic form, steam engine fluctuations varying 5 per cent from perfect regularity of angular motion, and gas engine fluctuations varying $6\frac{1}{4}$

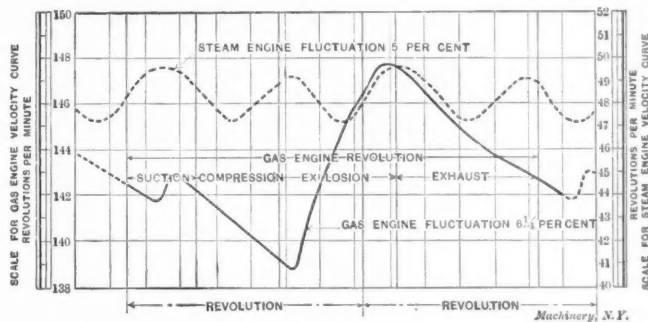


Fig. 1. Comparative Speed Variations of Gas and Steam Engines.

per cent. The Ransom cyclometer by which these variations were detected is of considerable interest and through the courtesy of the makers, Messrs. Manlove, Alliott & Co., Ltd., Nottingham, England, we are enabled to present herewith photographs of the instrument and the accompanying description:

The Ransom cyclometer shown in Fig. 2 is an instrument by means of which the time of rotation of any shaft may be measured to the one-five-thousandth part of a second and not only is the total time of each revolution recorded but also the time taken in turning through any minute angle or portion of a revolution may be obtained with equal accuracy. The principle upon which this speed recorder works is very simple. A cylinder or drum covered tightly with smoked paper is connected to the end of the engine shaft or other shaft whose speed it is required to measure. On one side of

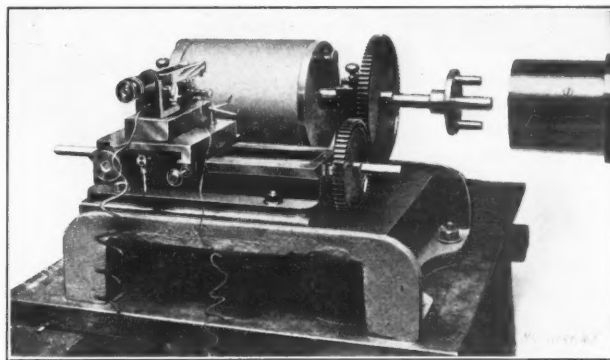


Fig. 2. The Ransom Speed Indicator.

this drum is mounted a tuning fork of known pitch one arm of which carries a small needle or style. When the fork is vibrating this needle oscillates in a line at right angles to the direction of rotation of the drum and lightly touches the surface of the smoked paper. Fig. 3 shows a short section of a record made by a standard tuning fork making 512 vibrations per second. It is one of the fundamental laws of sound that each vibration must be made in an equal interval of time, the amount of which is known from the pitch of the fork, hence each of the cycles represented on the surface of the smoked paper represent equal intervals of time. Knowing the pitch of the fork and having given a section of paper on which the style has traced a record, it can be readily deduced how long a period of time was required for the traverse of any portion of it while passing under the style.

In order that more than one revolution of the drum may be recorded the tuning fork is arranged to travel automatically along the whole length of the drum, or any portion of it that may be desired. The record then presents the appearance of a fine helix composed of waves on the surface of the paper. The records made on smoked paper are removed from the drum and the marks rendered permanent by a thin coating of varnish.

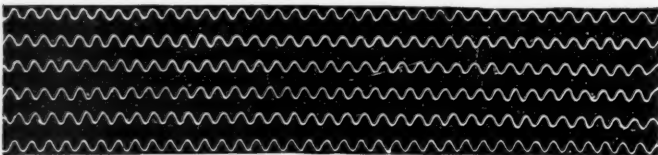


Fig. 3. Record Made on the Smoked Paper.

The diagram shown in Fig. 1 was plotted from tests made on a good tandem compound steam engine indicating about 15 horsepower, and on an "Atkinson cycle" gas engine. The gas engine shaft, of course, receives only one impulse to four impulses received by the steam engine shaft, and although both engines make about the same number of revolutions per minute it will be noted that there is a considerable difference in angular velocity. The gas engine was regarded as an uncommonly steady running machine, although the cyclometer showed fluctuations in speed of $6\frac{1}{4}$ per cent during a period of one revolution.

Fig. 2 shows the cyclometer; a spur gear is mounted on the drum shaft which meshes with another gear mounted on a lead screw. This latter traverses the carriage on which is mounted the tuning fork shown on top. Between the prongs of the fork is a small electro-magnet connected to a battery by means of which the action of the tuning fork is stimulated, and by the use of which a trial may be prolonged for any required time. The end of the drum shaft is provided with suitable connection for the shaft to be tested. It is thus evident that the construction and use of the instrument is quite simple and readily within the grasp of any one competent to test machinery. The fact that the tuning fork has an unvarying rate of vibration is, of course, the fundamental idea on which the machine is founded. The principle has been much used for time recording in physical science experiments but its application to machinery testing is of comparatively recent date. Fig. 4 shows the application of the instrument to an Atkinson cycle gas engine.

* * *

BUILT-UP CRANK SHAFTS FOR MULTI-CYLINDER ENGINES.*

In some of the very earliest gasoline vehicle engines of the high speed European type, built-up crankshafts were employed. That is, the shaft, its cheeks or webs, and the crank-pin were not made integral, but of separate elements, mechanically joined. In many of the early enclosed flywheel engines two balance wheels were used, each wheel being keyed to the closely abutted ends of the halves of the shaft. The crank-pin being passed through and made fast in the rims of both balance wheels, the halves of the main shaft were thus mechanically joined.

The built-up crank-shaft was early abandoned in favor of shafts hand or drop-forged out of a single piece of stock, the shaft proper, as well as the cranks and crank-pins for the number of throws desired, being formed integrally. Some of the highest quality automobile engines have been fitted with shafts not forged but machined or cut very laboriously out of a solid rectangular slab of steel, large enough to include the extreme outside dimensions of the shaft, cranks and pins.

* *Horseless Age*, July 4, 1906.

Crankshafts for four-cylinder engines are expensive pieces of mechanism, and the shafts required by six- and eight-cylinder motors are necessarily much more so, especially if they are constructed in accordance with the best precepts of the art.

Rather recently the built-up crankshaft has been proposed for modern motors, and several designs have been brought out. Such shafts are constructed upon a sort of unit system. The units from which a crankshaft of any number of throws may be built up are identical and consist of the forged cheeks of a crank, the crankpin and two short stubs forming parts of the shaft proper.

The ends of these stubs are made in the form of jaw couplings and two of the units may be united by interlocking these jaws, so that neighboring throws shall stand at any desired angular relation, one to the other, as required in the construction of multicylinder shafts of all types. The interlocked parts of neighboring units form the bearing portions of the shaft itself and the ball bearings in which the shaft runs do not, under this construction, have to be threaded over the cheeks of the cranks. The internal diameter of the ball bearings may therefore be reduced with an advantage in point of strength of the bearing.

It is probable that crankshafts built up in this manner from a number of similar units can be produced quite economically. The burden of keeping on hand ordinary crankshafts for motors of various types and numbers of cylinders is quite

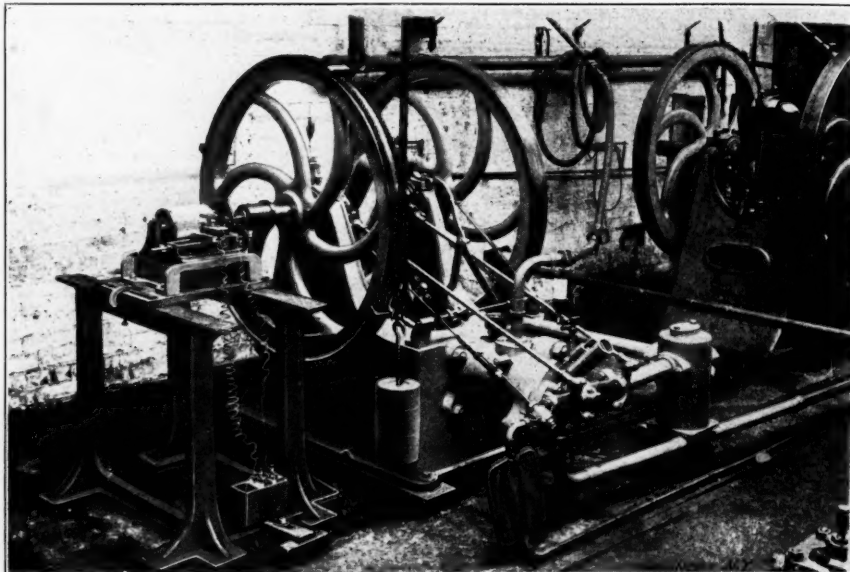


Fig. 4. The Apparatus in Use in Testing an Atkinson Gas Engine.

serious, and there should be a certain advantage in being able to build up a shaft for a motor of any number of cylinders upon this unit system.

Damage sustained by any part of a built-up shaft should be more readily repaired than a corresponding accident to an integral shaft—a fracture of which is usually fatal, despite the claims put forth for the electric welding process in this connection.

* * *

Every flywheel acts in a measure like a fan, taking in air at the hub and discharging it at the rim. The current of air set up in this way is often disagreeable and sometimes injurious to processes of manufacture. In any case it means a waste of power which with a large wheel running at high speed may be a considerable item. A writer in *Power* recommends that all flywheels be encased, the casing being made a part of the wheel itself and not in the form of a box surrounding it. A box casing surrounding the wheel only partially reduces the loss of power and is not as easily and cheaply made as drumhead casings applied to the wheel itself. These casings may be made of canvas supported on radial wires, and segments of wood fitted in the rim and a wooden clamp collar at the hub. With this construction the air within the wheel revolves with it without escaping; with a box casing it is being continually agitated, the fanning action being only partially suppressed.



WILLIAM B. COGSWELL.

REPRESENTATIVE AMERICAN MECHANICS AND ENGINEERS.

William B. Cogswell, mechanical engineer and general manager of the Solvay Process Company and the Tully Pipe Line Co., Syracuse, N. Y., was born in Oswego, N. Y., September 22, 1834. From seven to ten years of age he attended the Hamilton Academy; he afterward attended a school kept by Joseph Allen of Syracuse, and also a school kept by Prof. Orin Root, in Seneca Falls, N. Y. During the two years, 1848-9, Mr. Cogswell worked with an engineering party on the survey of the Syracuse & Oswego R. R. and the Syracuse & Utica R. R. His natural tastes impelled him strongly toward engineering as a profession, and when his surveying experience ended, he entered the Rensselaer Polytechnic Institute, at Troy, N. Y., May 1, 1850, in the class of 1852. He remained three years but owing to an extension of the course no class was graduated in that year. In the year 1854 the degree of C. E. was conferred on him by this institute.

Soon after leaving the school Mr. Cogswell began an apprenticeship in the Lawrence machine shop, under the superintendence of John C. Hoadley. He came out of that apprenticeship three years later with a theoretical and practical education in engineering, mechanics and physics with their allied branches, not often secured in so short a time by so young a man.

Returning to Syracuse in 1856 he was selected by George Barnes of the same city to assist him in taking charge of the machinery of the Marietta & Cincinnati R. R. at Chilli-cothe, of which road Mr. Barnes had been made superintendent. He remained in that position only three years when the railroad became crippled in the financial panic of 1857. The year 1859 Mr. Cogswell spent as superintendent of the Broadway Foundry in St. Louis, Mo., and in 1860 returned to Syracuse, and in conjunction with William A. and A. Avery Sweet, started the works which were the inception of the present Whitman & Barnes Manufacturing Co. Here the breaking out of the Civil War found him, and in 1861 he was appointed civil engineer in the United States Navy. In this position he performed an enormous amount of labor in fitting up separate repair shops for five stations on the Atlantic seaboard and lived at one of them erected on shipboard at Port Royal, S. C. In 1862 he was transferred to the Brooklyn Navy Yard and placed in charge of steam repairs where he remained four years. The following two years he lived in New York City. In 1870 he was called to take charge of the completion of the Clifton Suspension Bridge at Niagara Falls and at the same time gave his attention to the construction of two blast furnaces at the Franklin Iron Works in Oneida County, N. Y.

In 1874 he was solicited to go to Mine La Motte, in Missouri, to assume charge of the lead mines of the same name

at that point. This mine was owned by Mr. Rowland Hazard, who brought all arguments in his power to induce Mr. Cogswell to take this step. He remained there five years until the spring of 1879, when he decided to remove to Syracuse, although retaining the management of the Mine La Motte lead mines. After returning to Syracuse, and while in quest of some kind of employment, Mr. Cogswell decided on a step which has had a most important influence on Syracuse as it called into existence a new industry that has grown to great proportions. Through a friend he had made the acquaintance of Messrs. Solvay & Co., of Brussels, Belgium, who are the most prominent manufacturers in the soda industry in Europe, and he decided to go to Europe to investigate it. The result was that Mr. Cogswell was given a commission to inspect the various points in this country where a manufactory would be practicable, and report. After the receipt of the report steps were taken for the formation of a company for the manufacture of the various soda products. It was decided that Syracuse was the best point for the works and they were located there, for it was believed by Mr. Cogswell that rock salt might be discovered in the vicinity. Several experimental borings were made in 1881 and 1883, but without success; but information was obtained which led to the experiments in Tully valley in 1888, and the discovery of two veins of rock salt, each about fifty feet thick, at a depth of 1,200 feet. The company now receive their entire supply from the Tully wells. The company also put in a plant of such capacity that a large quantity of saturated brine is sold to the salt manufacturers of Syracuse. This industry led to the formation of the Tully Pipe Line Company, for conveying brine from the wells to the works.

A branch of the Solvay Works at Syracuse has been built at Detroit, and the output of the two works has probably tripled in the last fourteen or fifteen years. (In 1892 the output was 75,000 tons soda ash; 20,000 tons caustic potash; and 6,000 tons bicarbonate of soda.) An organization known as the Semet-Solvay Company is a branch of the same organization in the coke industry, and it grew out of the demand for ammonia required by the Solvay Company in their business. This branch has extended until they have banks of ovens located in twelve or fifteen different cities in the country, and is in extent probably as great as the soda ash business itself. Other industries have been engrafted on the original industry of making soda ash which was the first to be started by Mr. Cogswell, and in the introduction of others he has been instrumental, and when his best judgment has been followed there have been few mistakes.

The Hannawa Falls power plant, where the Racket River two miles above Potsdam, St. Lawrence County, offered a favorable opportunity, Mr. Cogswell organized and mainly financed the company that erected. Electric power is furnished to Potsdam and Ogdensburg.

Mr. Cogswell has in his life made the most of favorable conditions; inherited a good constitution; was brought up as a gentleman; started young in civil engineering; had a good technical education; learned the machinist's trade in one of the best shops in the country; and has coupled with these advantages a wide experience, and an abundance of good common sense. He is a member of the American Society of Civil Engineers; a member of the American Society of Mining Engineers; a member of the American Society of Mechanical Engineers; a Fellow of the Geographical Society; a member of the Society for the Advancement of Science; a member of the Society of Chemical Industry of England; and president of Warner's Portland Cement Company.

For the foregoing we are indebted to Memorial History of Syracuse published in 1891, and for later information to Prof. John E. Sweet, Syracuse, N. Y.

* * *

A movement inaugurated by Mr. Carnegie has resulted in the planning of a memorial building on the site of the birthplace of James Watt at Greenock, Scotland. The building will contain classrooms for the study of navigation and marine engineering, together with facilities for taking astronomical observations. Mr. Carnegie will bear a large part of the cost of this undertaking.

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SEPTEMBER, 1906.

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MACHINERY is published in four editions. The practical work of the shop, is thoroughly covered in the Shop Edition—\$1.00 a year, comprising more than 430 reading pages. The Engineering Edition—\$2.00 a year—contains all the matter in the Shop Edition and about 250 pages a year of additional matter, which includes a review of mechanical literature, and forty-eight 6x9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, \$3.00 a year, comprises the same matter as the Engineering. RAILWAY MACHINERY, \$2.00 a year, is a special edition, including a variety of matter for railway shop work—same size as Engineering and same number of data sheets.

THE VALUE OF A CAMERA AS AN INSTRUCTOR.

On another page of this issue is given a series of views contributed by Mr. H. P. Fairfield, showing kinesiograph fashion, the successive steps of a simple planer job. It shows at the same time common American practice in the production of machine parts which lend themselves to planing in groups. While these views are intended, of course, principally for the benefit of the younger reader they, also, may be found to contain hints for the older ones as well. In passing it might be remarked that the views show the planer to the best advantage, working as it is on a class of machine parts on which the milling machine can not successfully compete. But the principal point to be made is that a series of views like this tells more and does it better than can any word description. We believe the practice of photographing the successive steps of various machine operations would be one of the best means of education of apprentices and others, whether in trade schools or in shops. A picture tells its own story, faithful to the last degree, but not the same story to everyone; the young beginner will see the general scheme, but the old timer, in addition, will see points and matters for criticism as well as hints of value to be adopted in his own practice.

* * *

DEVELOPING INVENTIONS.

Occasionally the editor of MACHINERY receives letters from inventors who have conceived what they consider to be valuable improvements in machinery which they are, nevertheless, unable to develop properly because of lack of capital. It is rarely that we can suggest any help for such cases, much as we might wish to. The typical inventor is almost always in search of an "angel" who will play the fairy act and furnish him with the funds necessary to prosecute his ideas, and a common mistake made by inventors is in thinking that they must go abroad for capital. Notwithstanding the common acceptance of "a prophet is not without honor in his own country," the necessary funds for developing a really valuable idea often can be obtained in one's own native place, provided the subject is one of general application. In case the invention is one that applies to a trade already developed, being in the nature of an improvement, it is usually better to make terms with some concern identified with the trade, even if somewhat humiliating to pride and ambition, than to attempt developing the invention in competition with firms already established. Suppose, for example, that a valuable improve-

ment in making shoes by machinery has been made; it would be inadvisable under present conditions for an American inventor to organize a company to build his machines and place them on the market unless he can get the support of millions. He might better make such terms as he can with the powers that be and save his energies for further inventions. The one giant concern which dominates this field is probably the most shrewdly conducted monopoly that has ever been devised in the field of machinery, and it does not encourage the use of competitive machines. That it will always stand as such a dominating figure is not probable, but under the present conditions the average inventor could do little working in competition with it.

* * *

ALCOHOL ENGINE INVESTIGATIONS.

As the result of the passage of the bill allowing the sale of alcohol without internal revenue tax, the Department of Agriculture has decided to publish a bulletin on January 1, 1907, when this law comes into effect, giving the public a collection of the best obtainable data on the use of alcohol in small engines. For this purpose, Dr. Chas. E. Lucke, of Columbia University, New York, has been retained by the government as an expert to conduct these investigations in the laboratory of the University. It is intended that the bulletin shall contain all of the work done on the subject, both here and abroad, together with the results of the experiments and conclusions drawn therefrom on the American apparatus; it will, in fact, be a complete bibliography of the subject up to date.

The scope of the work being so extensive, Dr. Lucke is very desirous of securing the co-operation of everybody interested. Contributions of data and the results of previous investigations are requested, and if any of our readers have improvements on alcohol engine vaporizers, carbureters, etc., they are invited to submit their apparatus for tests in the laboratory. These tests will be conducted without any expense whatever to the public except for the transportation of the apparatus. The reports of the tests will be published in the bulletin. The apparatus will be returned when the work is completed.

* * *

THE BURGLAR AND THE SAFE MAKER.

Considerable commotion was caused among the manufacturers of safes by the advent of thermit a few years ago, and naturally so, as it appeared that this chemical, which gives the means of producing an enormously high temperature with very simple apparatus, might make it possible for burglars to attack the strongest safes and rifle their contents with ease. The use of thermit for safe-cracking does not appear to be very practicable, however. When the reaction of thermit is once started, it is no longer under control, and supposing that it were possible to use enough on a safe to melt a hole through it, the chances are that the contents would be consumed before the burglars could abstract them. The latest aid to burglars which would seemingly allow that gentry to do wonderful safe-cracking stunts on any kind of metal with ease, is the oxygen process which has been developed abroad for clearing out blast furnace tap-holes, etc. With the oxygen burner it is claimed possible to bore a hole through a hardened armor plate 9 or 10 inches thick in a fraction of a minute and that the control of the flame is so accurate that it would be possible to cut out a section of the plate to any required shape. The apparatus required consists essentially of a pair of flasks containing oxygen and hydrogen under pressure and a simple burner of modified Bunsen type. We speak of this not with the view of aiding the safe-cracking profession, but to show how the advance in the arts destroys the effectiveness of protective devices that have gone before. The battle between the burglar and the safe-maker has aptly been compared to the combat between the gun-maker and the armorer. Their work is futile, and if it were not for the benefits realized from the advances of armor-making, gun-making, etc., by other and more peaceful pursuits, it would seem to be very useless and wasteful business. As matters now stand there is no armor which a battleship can carry that cannot be broken with the best modern guns, and apparently there are no safes that cannot be opened by burglars possessed of the latest improvements for penetrating metals.

THE RATIONALE OF INDUSTRIAL BETTERMENT.

The editor of MACHINERY in a recent letter to the writer stated: "I find that while nearly all manufacturers with whom I have talked on the subject are entirely in accord with the efforts now being made to provide better surroundings for their operatives, some of them object to the introduction of social features in works management. The objection raised to these features is that they are liable to be construed as a form of paternalism which workmen strenuously object to. Perhaps I cannot do better than to quote the following opinion from a well-known manufacturer:

"We do not believe that it helps a man to give him something for nothing, and we do not believe that he wants it. We have seen in a great many instances throughout the country where various plans of this kind have been tried, that men rather resent it and look upon it as a charity which is not desired. We believe in giving a man a chance to earn his recreations rather than provide them for him gratis, and we feel that all plans worked out on a basis of giving a man something for nothing are bound to fail, for the very reason that it can be nothing other than more or less of a charitable distribution, and that the American workman is above anything of this nature."

"It seems to me that it is at this point where manufacturers frequently make a mistake, and any assistance that you can give to such of our readers as are looking into the subject will be appreciated, and I believe there is a chance that it will do a great deal of good."

The fact that the editor of MACHINERY feels that I can, from my experience in this new field of endeavor, be of assistance to the readers of his valued paper, who, I am glad to know, are interested in the subject, encourages me to seize the opportunity thus offered to meet the issue which is raised by the manufacturer above quoted, for, I feel that there are some who, like the latter, have a misunderstanding of the object of the features referred to, and there are also some, who, like those of whom he writes do not understand at all what these features mean. Before touching upon the phase of the subject which is here alluded to, let me for a moment consider the origin of the general movement in which it is involved.

Somewhat more than a quarter of a century ago the German government, impelled by paternalistic motives characteristic of its monarchical system, introduced into some of its subsidized industrial establishments certain features which were intended solely to improve the condition of the workers. These were appropriately termed Wohlfahrt's Einrichtungen, or "welfare institutions." These features, consisting of lunch rooms, rest rooms, libraries, emergency hospitals, gymnasiums, athletic grounds vegetable gardens, and the like, had been tried by certain manufacturers in England and elsewhere who were altruistic in their nature and co-operative in their beliefs. American manufacturers, driven by the fierce competition of the times to adopt every possible means of increasing the efficiency of their plants, were traveling abroad to study foreign industrial methods, and seeing these "institutions," were at once impressed not only with their novelty but with the improvement in the general prosperity of the enterprises in which they had been introduced. They saw at once that these improved conditions were attracting a better class of operatives, that the latter were doing more and better work, and that this resultant high-grade product was obtaining higher prices in the market. Impressed with the idea that there were economic principles involved in these features which they could not afford to ignore, they carefully investigated them, and on their return home proceeded to try them out under conditions as they existed in their own establishments.

It soon became apparent that fundamentally these institutions were not only ethical, but economic. That the so-called enlightened selfishness exemplified in the Golden Rule pays its possessor many fold.

It was evident that the better the operatives were housed and fed, and the better their habits were outside of working hours, the better would be their general physical condition and the more regular would be their attendance; that the higher their mental attainments the more intelligently they would conserve their strength and apply their knowledge and

skill and the business would thereby be improved and the profits increased.

It became evident, however, that the democratic tendencies of American workmen would not allow these features to be applied in the paternalistic manner adopted by the German manufacturers. Our people had been brought up to be independent and self-reliant, and resented having forced upon them anything which savored of charity. Now, manufacturers had long learned that machines represent capital invested and that the only time this investment is earning interest is when the machines are running and turning out product to be sold, so that any means that could be adopted that would tend to keep the machines continuously productive and at the same time insure high grade of product, would raise the interest on the investment. They soon realized that these features which they were investigating were productive of exactly what they were desirous of accomplishing, and they lost no time in introducing them in their establishments with such modifications as they found were necessary in transplanting foreign institutions to new soil.

The remarkable results which attended the intelligent installation of these features, which were given the appropriate appellation of "Industrial Betterment" led other manufacturers to their adoption, but many of the latter, not realizing their fundamental object, applied them indiscriminately and scored failures. They seemed to think the motive was essentially altruistic and adopted paternal methods of applying them, calling them "welfare work" and arousing well-merited resentment. The correspondent to whom the editor refers says rightly that there are "a great many instances throughout the country where various plans of this kind have been tried" which have not met with success, but these failures have been due to a lack of understanding of the purport of the installation and accompanied by ignorance of the proper method of its introduction. He, himself, misunderstands the purport of the movement and cannot see the benefits which have accrued in those other instances where the installation of these features has been a great success. The term "welfare work" has misled him.

There are plenty of men who mistake the substance for the essence who "cannot see the forest for the trees." There is no "welfare work" about it. It is "Industrial Betterment."

It is efficiency of organization that the modern business man is anxious to secure, and this can be obtained by "Industrial Betterment" intelligently installed. This is no longer in the experimental stage; it has too often proved successful, and the manufacturer who delays its adoption is simply closing his eyes to the advance of the times and to one of the most potent means of promoting his own interests.

H. F. J. PORTER.

* * *

The novelty of an invention very often consists in the recognition of a want rather than in the specific form in which this want is satisfied. Many of us go through life knowing in a vague way that certain ways of doing things are not quite satisfactory, but when some one recognizes this fact and provides a tool or device which accomplishes the work much more easily and satisfactorily than before, we are all prone to wonder why we had not thought of the same thing ourselves. The point is, that when the need was fully recognized the tool or device necessary for forming the required work was a comparatively simple accomplishment. The need of some devices, however, is so obvious and has been recognized by so many people that thousands of inventions have been devised to fill the want, as, for example, the car coupler and the non-refilling bottle. To make the business of inventing pay, the inventor must, in general, recognize a need before others do.

* * *

The use of opaque or ground glass for the lower sections of shop windows is often desirable, but it is not advisable unless the interior has a clear unobstructed view in some direction of, say, one hundred feet. The reason is that men working on anything requiring close attention of the eyes are likely to suffer from eye-strain if they cannot occasionally relieve the strain by focussing them on some distant object, and this cannot be done in a small room with opaque glass in the windows.

ENGINEERING REVIEW.

CURRENT EVENTS, TECHNICAL AND MECHANICAL—LEADING ARTICLES OF THE MONTH.

The *Engineering Record* reports the use of the electromagnet in recovering lost drill points at various places in Pennsylvania. At Greenburg a heavy point stuck at a depth of 250 feet in a well, but it was readily loosened and brought to the surface by an electromagnet.

It is reported that the Carnegie Steel Company will drill a well 6,000 feet deep in the gas field near Waynesburg, Pa. It will be done to test a theory that the gas sands now being developed are only the top or secondary sands, and that the primary and principal producing sand strata will be found underlying it several thousand feet. The experiment is attracting considerable attention, not only because of the possible discoveries but for the special derrick and machinery required for drilling such a deep bore.

It is reported in *Page's Weekly* that there is a likelihood of a revision of the agreement entered into by the English Engineering Employers' Federation and Amalgamated Society of Engineers. This historic agreement was adopted after the great strike in 1897. The scope of the proposed changes may be indicated by three suggested amendments. One is that the Federation shall recommend the preferential employment of society men, instead of leaving firms to employ whom they choose, a freedom of management for which the federated employers sacrificed so much in 1897; another seeks to limit the number of apprentices; and a third asks that the maximum overtime shall be 20 hours per man per month, instead of 40 hours, as at present.

It is stated in the *Engineering Record* that in the survey of a new 14-foot water way between Chicago and St. Louis the leveling for a distance of 334 miles was done with a probable error for the whole length of only about 13.55 millimeters, or slightly over one-half an inch. The level was protected from the sun by one large umbrella, while another, held by a rod stuck in the ground, cut off the wind. When the immense distance covered is considered, the error is so slight that the instrument used ranks in accuracy with the finest tools employed in machine shop measurements. It is quite possible that the transit as employed to some extent by the Westinghouse Electric and Mfg. Co. and others, deserves a larger field of usefulness in the machine building business.

The United States Consul at Venice says that some of the high-power motors in the Monte Carlo races had a universal joint in the shaft, between the motor and the thrust bearing, so that the possible deviation of the shaft from a straight line, through vibration, or the straining of the boat, would not affect materially the running of the motor. This feature is believed to be valuable even on the smaller boats. Another feature of interest was the seemingly exaggerated precautions against eddies, such, for example, as tapering the end of the shaft to a point beyond the propeller, and also the knife-edge of the stem. In a series of experiments made last year by a Scotch designer, the difference in the fineness of the stems of ships has been shown to influence their speed very materially, and this seems to have been taken into account in the construction of the racing boats of this year.

There has long been a demand for some arrangement by which the amount of material remaining in a bolt of ribbon or cloth can be ascertained at a glance. As a means of doing this the suggestion was made that a tape be wound up with the ribbon, the tape being marked with inches, feet and yards, but when this was tried, it was found that there was a serious discrepancy in the respective lengths of the two pieces. This difficulty has now been overcome by slitting the paper tape at regular intervals, and passing the ribbon in and out through these slits. This innovation, which is the invention of a Chicago ribbon manufacturer, will not only be of great assistance in the shop, where the ribbon may be measured

off in the required quantities without the use of a yard-stick, but will be also found to greatly facilitate the work of stock taking, which in the case of ribbons, cloths, and similar materials is a very tedious operation.—*Scientific American*.

In connection with the recent launching of the *Lusitania*, *Engineering*, of London, gives some figures showing the total tonnage of the recent launches on the river Clyde. The month of June, 1906, will long be remembered for its record in this respect, the total being 124,544 tons, which is very much greater than the figures for any previous month. This great increase is of course accounted for by the coincidence that the Cunard liner *Lusitania* and the battleship *Agamemnon* both happened to be ready for launching about the same time. Without these two larger vessels, however, the other 34 craft make the very respectable aggregate of 75,544 tons. The total for the last six months stands at 335,258 tons, a record which probably will not be surpassed for some time to come, as new contracts are not being placed so rapidly now as they were two or three years ago.

A correspondent of the *London Times* in the engineering supplement of that journal states that what is believed to be the largest and heaviest lathe yet built has recently been furnished by Messrs. Hulse & Co., of Manchester, England, to the shipbuilding firm of Messrs. R. & W. Hawthorne, Leslie & Co., of New Castle-on-Tyne. This lathe is to be used in machining the rotor and other parts of the steam turbines which are building for the Cunard express steamer *Mauritania*, sister ship of the *Lusitania*. It will take work up to 16 feet in diameter over the carriage or 18 feet over the ways if the work is held on the faceplate. The bed is 18 feet wide by 68½ feet long and work 50 feet in length may be held between the centers. The machine is operated from platforms, and short ladders are necessary to enable the workman to mount the platform from the level of the bed. While longer lathes have been built for such work as gun turning and boring, and lathes of larger swing have been built for turning flywheels and other such work, it is doubtful if a larger lathe for general purposes has ever been built.

A commercial combination of a peculiar character is reported from England. The firms manufacturing coal cutting machinery have been troubled by colliery owners who have asked to have machinery put to work in their mines on trial. Owing to the competition in this class of machinery the builders have been forced to do this. The mine owners have taken advantage of this competition and have lengthened the trial period by all means possible from month to month, thus getting extended service from the machinery without having to go to the trouble of purchasing it. When they could no longer use them free, many of them have sought to enter into arrangements whereby they could rent the machines for a comparatively low price. This has also proved unprofitable from the manufacturer's standpoint, since rented machinery is very naturally used much harder and is less well-cared for than that which is owned by the users. The new combination is based on an agreement of the builders of coal cutting machinery to refuse to rent their product and to refuse trial of the machines except under certain definite restrictions.

The *Engineering Record* reports some tests of steel at low temperatures made during the past year at the Watertown Arsenal in Massachusetts. The steels tested varied in quality from 0.16 to 1.09 per cent carbon. The elastic limit of the steel in one of the bars was 80,000 pounds per square inch, with an elongation of 10.7 per cent at the low temperature of the liquid air. A similar specimen tested at a room temperature of 76 deg. Fahr. showed an elastic limit of 52,800 pounds per square inch, an elongation of 29.3 per cent, the effect of the very low temperature being to increase the elastic limit of the steel 51 per cent, while the ultimate strength of the steel was raised to 97,600 pounds per square inch, or 35 per

cent above the ultimate strength at ordinary temperatures. The results of these experiments are similar to those that have been obtained by numerous other experimenters, who have investigated the properties of steel under the same conditions, in that it is shown that a great increase is produced in the tensile strength of steel at low temperatures, with a corresponding decrease in ductility.

THE ACTION OF THE CAPPED SHELL.

There is something mysterious in the action of the well-known soft metal cap for armor piercing shells, such as was illustrated in the article on projectile manufacture in the August issue. Perhaps the most commonly accepted theory to account for its effectiveness is that which considers it as melting at the instant of impact, and acting as a lubricant for the nose of the shell during its passage through the armor. This idea is untenable, however, since it would hold true in the case of penetration of soft armor only, and not in the case of hardened steel where the metal is cracked and shattered. In reality the device is more effective when piercing hardened materials than it is for softer ones. An army officer contributes to the *Journal of the United States Artillery* a translation of a paper read by a German engineer, who ascribes the effect to a different cause. He considers it to be due to the fact that the point of the projectile is by this means saved from deformation at the instant of the impact. The mass of soft metal in which it is imbedded acts as a cushion and distributes the pressure over a fairly large cross section, instead of allowing it to concentrate on the point, which it would otherwise fracture. This point is thus preserved to act as an effective chisel in piercing through the hardened outer layer of the armor plate; the wedge shaped body of the projectile following, serves to increase the opening thus effected.

RELATIVE ECONOMY OF STEAM AND GAS ENGINES.

At the recent meeting of the Ohio Society of Mechanical Engineers, Mr. J. R. Bibbins presented a paper on "Gas Engines in Commercial Service," which was accompanied by a chart that showed very clearly the comparative economy of steam and gas engines, in so far as fuel is concerned. This chart is presented herewith. The performance of the steam

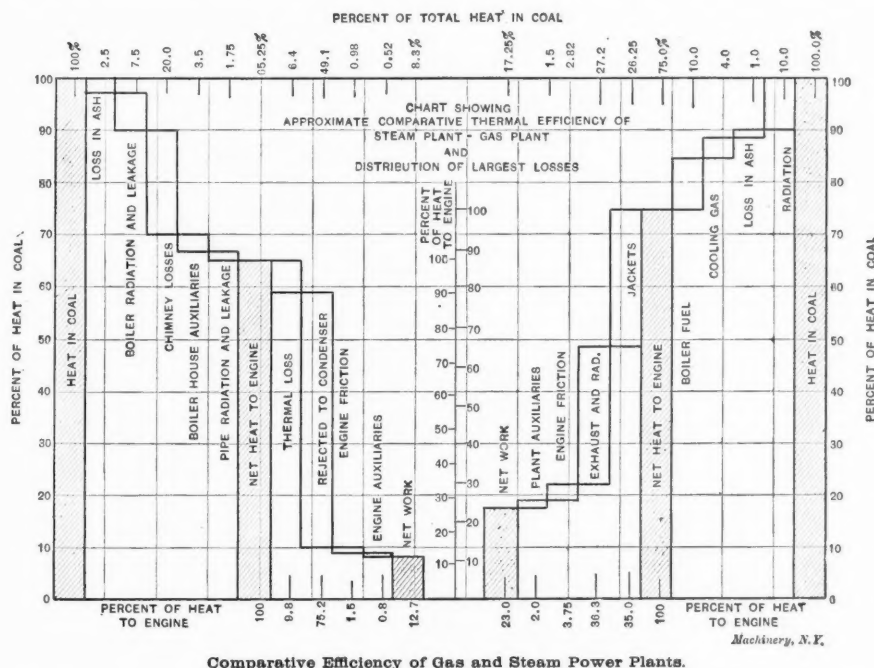
"Starting with the heat in a fair grade of steam coal, 13,500 British thermal units per pound, we find 35 per cent of this heat dissipated in the boiler plant and piping system, and 25 per cent in the producer plant. Fifty-seven per cent is, however, dissipated in a steam engine, and approximately the same in the gas engine, leaving 8½ per cent net output for the steam plant and 17¼ per cent for the gas plant. Thus on a heat basis, gas is twice as efficient as steam. Part of the advantage lies in the more efficient converting properties of the producer and the remainder in the higher thermal efficiency of the gas engine. In natural gas plants where no producers are necessary there is, of course, no question as to the superior economy of gas.

"Granted the superior economy of the gas plant, it is also necessary to take into account not only operating costs, but investment costs or fixed charges to arrive at a proper conclusion. Without going into this economic problem here, it is sufficient to say that plants of a few hundred kilowatts capacity may quite possibly cost more per kilowatt than a steam plant of corresponding size and character, but the saving in the operating expenses will soon wipe out the excess cost and eventually put steam 'out of the running.'" W. B. JR.

ACETYLENE GAS FOR WELDING.

Under the heading "Autogenous Welding of Metals by the Oxy-acetylene Blowpipe," M. Andre Beltzer gives a description and illustration of apparatus for this process in the *Electrochemical and Metallurgical Industry*. The oxy-hydrogen blowpipe has been used for this purpose, but is expensive and unsatisfactory, where much heat or high temperature is required. Acetylene gas is more suitable on account of being cheaper, and also because the temperature of the flame is much greater, being about 6300 degrees F., while that of hydrogen is about 3600 degrees F. The obstacle that has stood in the way of using the acetylene blowpipe has been the high price of oxygen. M. Beltzer states, however, that oxygen can now be obtained at a reasonable price by the use of a newly-discovered product called "epurite." This substance contains oxygen in a latent form which can be easily liberated by contact with water, the same as acetylene is obtained from calcium carbide. When oxygen is obtained by this process, not only is the cost reduced to a reasonable point, but all danger of explosions arising from the use of gas confined under high pressure in tanks is removed. An oxy-acetylene blowpipe welding outfit provided with an "epurite" oxygen generator is illustrated diagrammatically on the following page.

One of the oxygen generators *A* is charged with water and epurite. In the receptacle *C* is a solution of sulphate of iron, which is allowed to flow into the generator to act as a catalytic agent for the generation of oxygen. The oxygen liberated passes into the gasometer *D*, and is compressed to 10 atmospheres by the compressor *E* in the tank *F*. From the tank the gas passes by a tube through the pressure regulator *G* and valve *H* to the blowpipe *K*, where the oxygen should arrive at a pressure of 60 inches water. The acetylene apparatus *NM* is arranged so as to give the gas at the above pressure. This pressure of 60 inches water is calculated so that the exit speed of the gas will counteract the possible back burning of



engine, from the coal pile to the work done is shown on the left side, and the performance of a producer gas engine on the right side. In reference to this chart, Mr. Bibbins says:

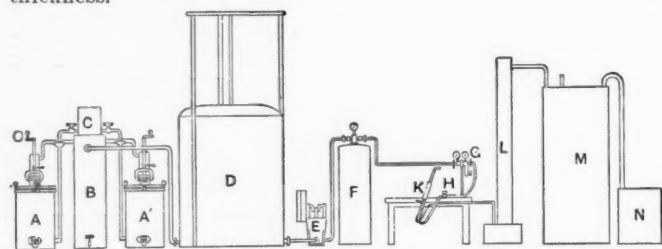
"In the accompanying chart the writer has attempted to make an approximate distribution of losses in various parts of the plant, based upon observations from numerous sources on each of its component parts. It is believed that the estimates are not unduly partial to either a gas or steam plant of moderate size.

the mixture before reaching the end of the blowpipe.

The blowpipe is provided with metallic gauzes to prevent the flame throwing back. The valve of the acetylene tube (fixed to the blowpipe) is at first turned on full, the pressure regulator being adjusted to about a one-half atmosphere. The flow of oxygen is controlled by a valve *H*, so that there is only one inner cone in the flame which will have only slight fluctuations. The flame now is neutral and ready for use.

A whiter color of the flame and the division of the inner

cone in two are indications that there is an excess of acetylene gas, and that the flame is carburizing, the molten metal emitting sparks like stars (formation of cast iron). When the flame is oxydizing (shown by the violet tint of the flame) the metal boils and is very bright. For proper welding (steel sheets, for instance,) the joint should be bright. The carburizing flame gives a gray porous and non-resistant welding. This flame, together with an oxydizing flame, gives a brittle welding, and is, moreover, very rarely used. Twenty different sizes of nozzles can be used on the same blowpipe in welding of all thicknesses, from 0.04 to 1¼ inch thick (0.024 inch for sheets 0.04 inch thick, and 0.16 inch for sheets 1¼ inch in thickness).



Apparatus Required for Welding with Acetylene.

During the process of welding, the apex of the cone must be from 0.08 to 0.12 inch distant from the object to be welded. The two edges (previously dressed) are fused, and simultaneously lined and slightly overloaded by the fusing of a rod of the same metal held in the flame. In this manner iron, steel, copper, brass, cast iron, etc., can be effectively welded. For thick metals or plates it is necessary to bevel the edges, which can be readily done by many mechanical methods.

For brass it is necessary to fill up the interstices of the two sheets to be welded with borax moistened with water, otherwise the volatilized zinc would be deposited on the welded part as oxide of zinc and spoil the welding.

From tests made by the International Bureau Veritas, in Paris, it has been found that the tensile strength of welds made by this process is within 5 per cent of that of the metal itself. The cost of the process for sheet metal work is less than riveting for thickness under about five-sixteenths of an inch.

W. B. JR.

IMPACT TESTING MACHINE.

In testing metals to determine their resistance to impact, two methods are commonly used. One is to strike a single blow strong enough to bend or break the test piece; the other is to strike numerous light blows and ascertain the number required to produce fracture or actual breakage of the specimen. The latter method is the most desirable because it gives the strength of the metal when subject to the conditions it has to meet in practice. When the test piece is struck many blows, it is necessary to rotate it through half a turn at each blow so that it may be bent or sprung back and forth with the successive blows. If this rotating is done by hand it takes considerable time, so that only a comparatively small number of blows can be struck, five or six hundred. For the purpose of conducting certain impact tests, the National Physical Laboratory of England has had designed and made a machine in which the test piece is turned through 180 degrees at each blow automatically. This machine strikes about forty-five blows per minute, which are recorded by means of a registering apparatus attached to the shaft. The construction and operation of the machine can be understood from Figs. 1, 2, and 3, together with the following description, which we reproduce from *Engineering*:

The hammer, A, is provided with a hardened-steel shoe where it comes into contact with the specimen, and two side-rods passing through the base-plate and terminated by a cross-head, B. The cross-head is fitted with a small roller for engagement with the lifting cam, C, and with two conical rollers working in vertical guides, D, which take the hori-

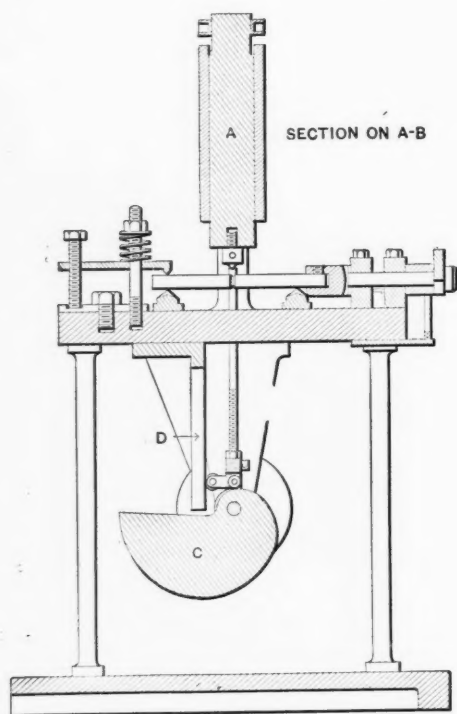


Fig. 1.

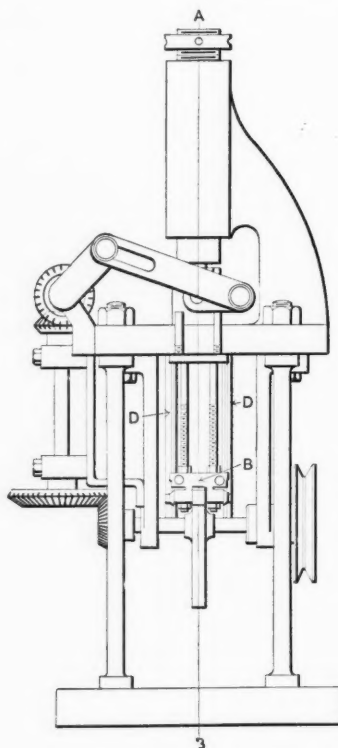


Fig. 2.

An Impact Machine for Testing Steel Specimens.

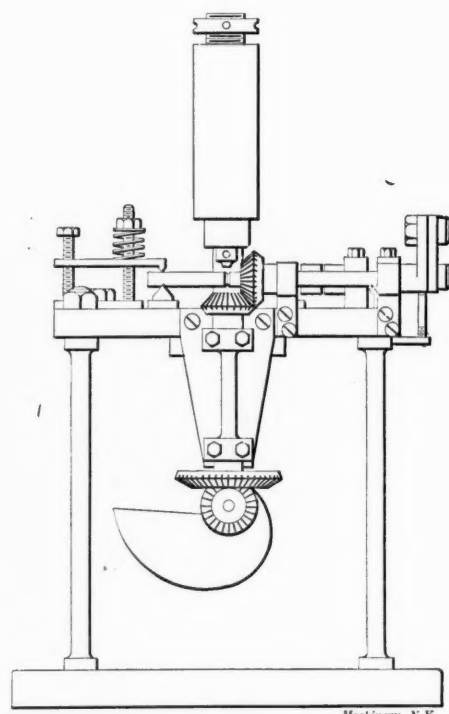


Fig. 3.

Cast iron, which cannot be self-welded, must be brazed with copper.

One decided advantage of the oxy-acetylene flame over the oxy-hydrogen is, that it can be easily regulated by the workman, owing to its brightness. Another advantage is that the gases formed by the combustion are hydrogen and carbon oxide, which combine with the surrounding air, forming carbonic acid and water, thus protecting the molten metallic surfaces from the oxidizing action of the air.

zontal thrust of the cam. The side-rods are attached to the cross-head by lock-nuts, so that the fall of the striking hammer can be regulated from 0 inch to 3½ inches. The cam shaft makes approximately 45 revolutions per minute.

To rotate the specimen through 180 degrees between successive blows a link motion is employed, which is worked from a countershaft parallel to the specimen, and revolving at half the speed of the cam shaft. A second shaft, whose axis coincides with that of the specimen to which it is coupled,

receives its motion from the countershaft by means of the two cranks and slotted link shown in the figures. By correctly proportioning the length of the slot, it can be arranged so that when the motion of the crank on the countershaft is continuous, that of the crank on the second shaft is oscillatory through an angle of 180 degrees.

In order that the second shaft shall not interfere with the free vibrations of the specimen when struck, its attachment to the specimen is made by a semi-Oldham coupling, which is set so that the plane of its slot coincides with the plane of free vibration of the specimen. The knife-edges on which the specimen rests are made of V shape, so that there is no tendency for the specimen to move sideways. The specimens are $\frac{1}{2}$ inch in diameter, the knife-edges being $4\frac{1}{2}$ inches apart. The diameter at the bottom of the notch is 0.4 inch.

If the fall of the hammer is adjusted so that the specimen will bear not less than, approximately, two thousand blows before fracture, there is no appreciable permanent set in the specimen until a comparatively short time from the ultimate fracture. The manner of failure of the specimens, whether of soft or hard material, is that a crack is developed on each side of the specimen in the plane of the notch, the two cracks proceeding inwards as the test proceeds.

The machine seems likely to be of considerable service in the impact tests of mild steels which cannot be broken, even when notched, by the single-blow bending method. The following is an example of a set of tests made on a sample of mild steel:

Fall of Striking Hammer in inches.	Energy of Blow in inch-pounds.	Number of Blows for Fracture.
0.77	3.62	4,950
0.50	2.85	12,400
0.30	1.41	44,634

W. B., JR.

NEW GERMAN TURBINE.

The *Gesellschaft für Elektrische Industrie*, of Carlsruhe, in Baden, Germany, has brought out a type of steam turbine which, while not new in principle, is different from the design that is almost universally used, at least by the large manufacturers. This turbine is shown in Figs. 1, 2 and 3, the first being a vertical section at right angles to the shaft, the second a vertical section parallel with the shaft, and the third a perspective view of the wheel. As will be seen from Fig. 1, this is a four-stage turbine, in which the stages are obtained

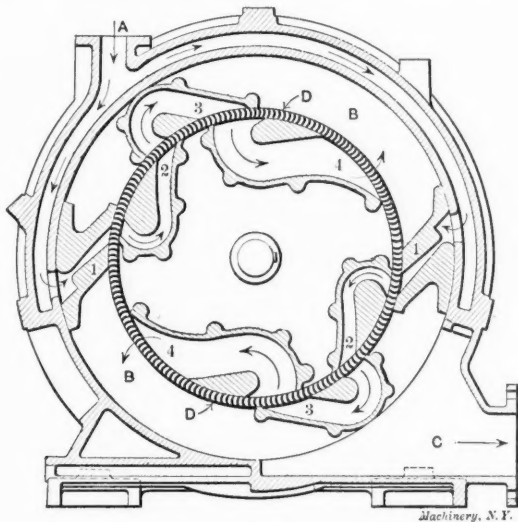


Fig. 1. Cross-section of a German Steam Turbine.

by passing the steam through the buckets of the wheel four times. Steam enters at A and passes from nozzles 1 through the wheel buckets to nozzles 2, thence through the wheel a second time to nozzles 3, and a third time through the wheel to nozzles 4; the fourth passage through the wheel carrying the steam to the spaces B, from whence it passes to the exhaust pipe C. When we consider that in the designs in which each stage requires one wheel, the first few wheels do not utilize more than a small portion of the periphery, we can easily see that the construction here shown should afford the

means of producing a decidedly compact machine, and probably at a lower cost than the multi-wheel type. On account of the compact construction, this turbine should be well adapted to launches. Fig. 2 shows a reversible boat turbine. It is made with a wheel having buckets on both sides, the

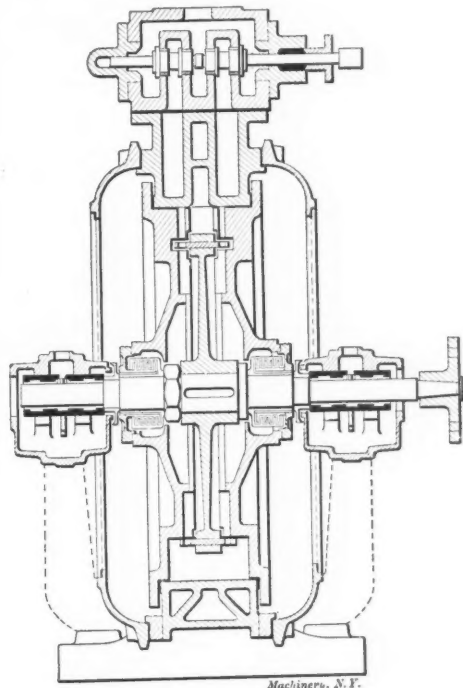


Fig. 2. Arrangement of Reversible Marine Turbine.

buckets and nozzles on one side running in the opposite direction of those on the other side. By means of the valve seen above the turbine casing, the steam can be directed to either side to produce rotation in whichever direction is desired.

W. B. JR.

OLD STEAM ENGINE AT THE VERSAILLES WATER WORKS.

Revue de Mecanique, May 31, 1906.

In the early part of the nineteenth century when the reconstruction of the pumping station for the Versailles water works was under consideration it was proposed that a steam engine be substituted for the water wheels previously used. The matter was placed in the hands of a commission in 1811, but it was not until October 14, 1821, that the matter was settled and the foundation laid.

The installation included a steam engine and boiler as well as the cast-iron piping a foot in diameter. Like the majority of steam engines of the day, the machine that had been proposed by M^{rs}. Cooke and Martin was of the beam type, working under a low pressure and condensing. The steam cylinder had a diameter of 42.6 inches and a stroke of 76.77 inches with a thickness of shell of 1.42 inch. It was fitted with a steam jacket, and the steam distribution was effected by means of two valves driven by an eccentric mounted on an intermediate shaft to which the main crank was attached at the end of the beam on the opposite side from the cylin-

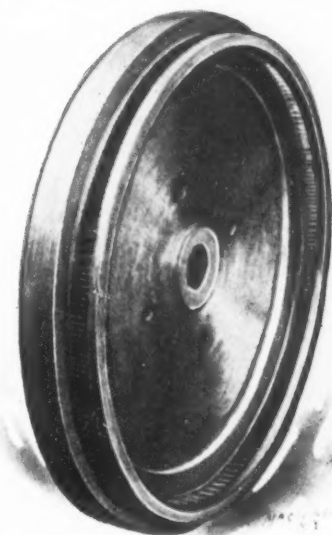


Fig. 3. Construction of the Wheel and Blades.

der. This eccentric also, by means of a lever, drove the pump by which the boiler was fed.

The piston rod of the condenser air pump was attached to the beam on the same side as the steam cylinder. The

obtain a gradual and uniform tightening of the packing, as seen in Fig. 2.

After having done its work in the cylinder, the steam passed by way of a cast-iron pipe to the hot well of the condenser,

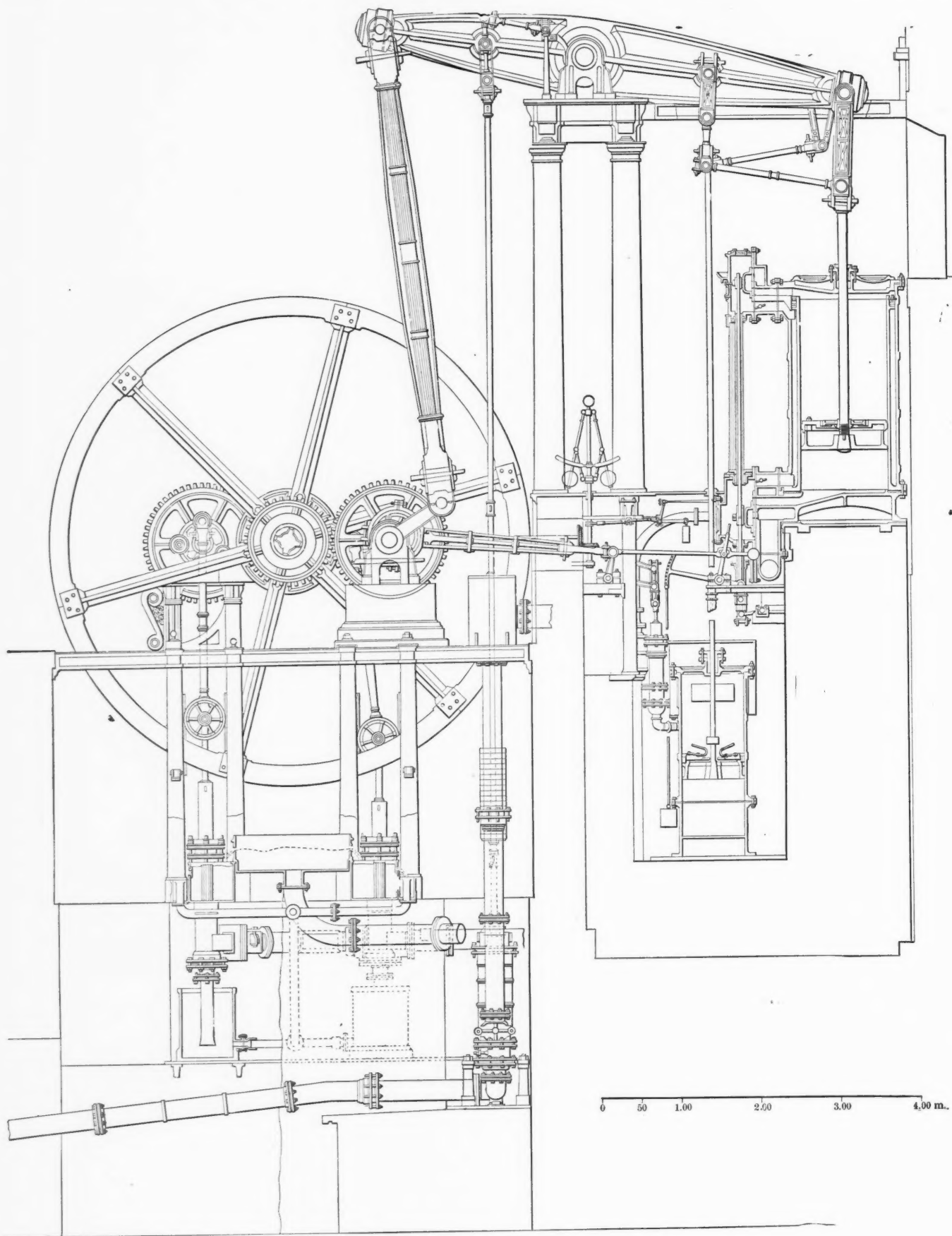


Fig. 1. Elevation of the Versailles Water Works Engine at Marley.

arrangement of the cylinder and the details of the valve mechanism are shown in the side elevation (Fig. 1) of the engine. It may be noted that the cover serving to form the joint of the piston was fitted with a toothed wheel so as to

as shown in the side elevation and vertical section, Figs. 1 and 5. A jet of cold water was injected into this hot well and completed the condensing, the whole being encased in a large tank of cast iron, into which the water drawn from

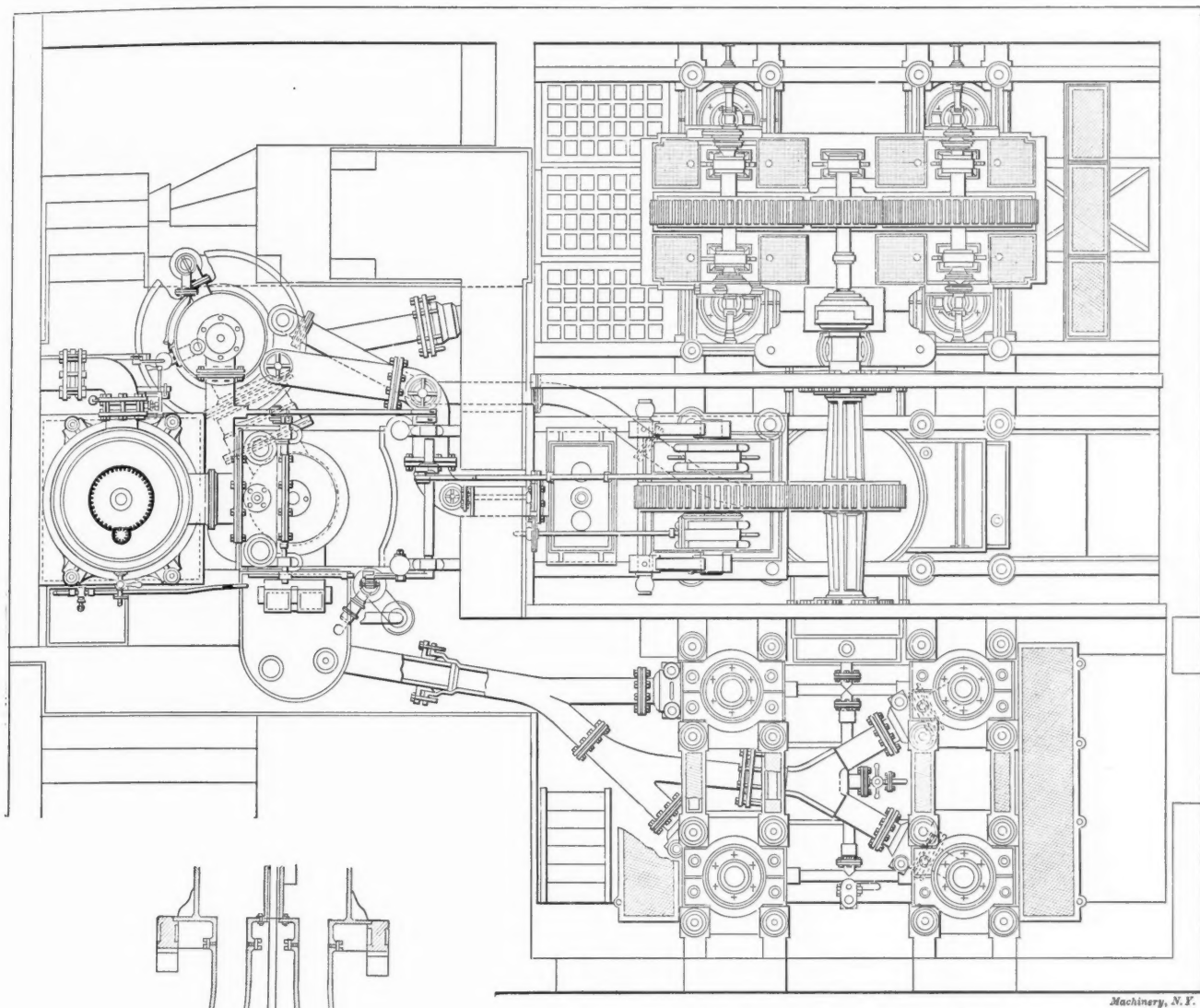


Fig. 2. Plan View of Pumping Engine.

Machinery, N. Y.

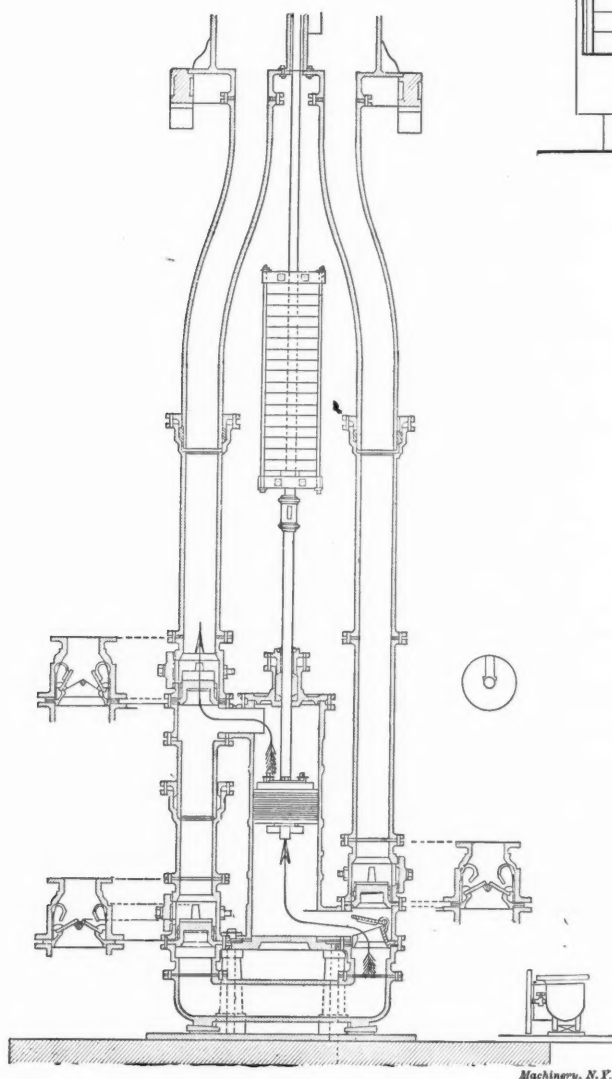


Fig. 3. Cross-section of Supply Pump.

Machinery, N. Y.

the Seine went before entering the eight pump cylinders which forced it into the aqueduct.

The piston of the air pump is 29 inches in diameter, and delivers hot water into the tank which is to be seen at the left of the pump in Fig. 5, and from which the feed pump of the boilers also draws. The surplus of hot water which does not go to the boiler passes by a system of pipes to one of the cast-iron water tanks, located alongside the stairway of the approach to the building. All of this machinery, which is remarkable in its finish, was furnished by the Creusot shops. The trunnions of the beam are carried by four cast columns set upon a heavy masonry foundation, and an iron balustrade broken by monumental candelabra surrounds the steam engine.

The power of the cylinder was calculated to be sufficient to furnish 64 horsepower of 75 kilogrammeters per second at 14 revolutions or 14 double strokes a minute with a steam pressure of 4.5 inches of mercury or about 2 pounds per square inch. When working in this way, the engine was capable of raising 1,800 cubic meters (296,000 gallons) of water per day to the Louveciennes aqueduct. This work necessitates the consumption of about 10 tons of coal per day.

The two connecting rods fastened to the end of the beam drive cranks keyed to the ends of the first transmission shaft, which carries at its center a gear of 57 inches diameter. The eccentrics controlling the steam distribution are also keyed to this same shaft on either side of the gear. This latter meshes in with a second of 43.3 inches diameter, which is keyed to a second transmission shaft, which carries gears at each end driving a group of four pumps. On each side, between the central gear and those at the ends there is a large flywheel and a clutch coupling, so that either group of four pumps can be cut out if desired.

Each of the gears at the end of the second transmission shaft meshes with another of 57 inches in diameter, which is mounted

on the center of a shaft, at each end of which there is a crank driving a suction and force pump. Each shaft thus controls two pumps and as there are two groups of four pumps each, that forms the basis of the system.

The eight pumps just described do not draw directly from the river, but from cylinders placed directly beneath the body of the pump as shown in the side elevation, Fig. 1. These cylinders were fed from below by means of a system of piping starting from small cast-iron basins placed on a level with the upper part of the body of the pump. These basins were fitted with overflows and water-inch marks so that the amount of water which they delivered could be regulated according to the delivery of the force pumps, as shown in Figs. 1, 2 and 5.

The supply for the basins just mentioned was effected by means of a supply pump shown in detail in Fig. 3. This pump was driven by means of connecting rods attached to

April 17, August 5, and September 5 but it was not until May 5, 1827, that the engine was set regularly at work.

The following are the best results that could be obtained with this engine in the course of some accurate tests made in 1851, many years after it had been completed and after a number of improvements had been made:

Steam pressure.....	15 inches of mercury (7½ pounds).
Vacuum in condenser.....	25 inches.
Speed	16 revolutions per minute.
Power in cylinder.....	95 horsepower.
Water raised per day.....	548,670 gallons.
Power in water raised.....	50 horsepower.
Anzin coal consumption per hour.....	917.4 pounds.
Heating surface of boilers.....	343 square feet.

The boilers had a firebrick furnace set beneath a cylindrical shell 6 feet 9 inches in diameter and 9 feet long. These boilers were replaced ten years later by others having fire tubes

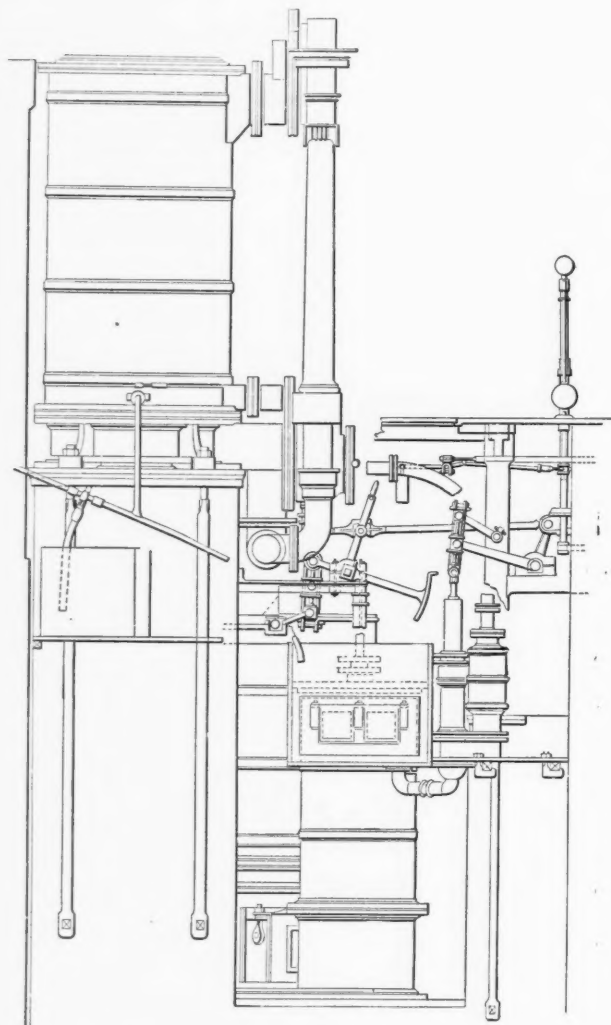


Fig. 4. Elevation of Condenser and Valve Mechanism.

the beam of the engine and drew its water from the river through a pipe passing beneath the Saint Germain road. The delivery was effected through two columns fitted with bronze clap valves, and delivered into a rectangular cast-iron tank set above the pump, and slightly below the level of the transmission shaft. Cast-iron piping led from this tank to the envelope of the condenser.

From the envelope of the condenser a second system of piping led beneath the center of the cast-iron tank already mentioned. The water, after having reached the center of this cast-iron reservoir, went into three settling tanks, from which it flowed as previously stated, to the suction tank set beneath the force pumps.

This engine which was not finished until 1825, was run for the first time on July 20, but only for a moment, because of the breaking of the teeth of the gear driving the pump shafts. Trials were made the following year on February 15, March 5,

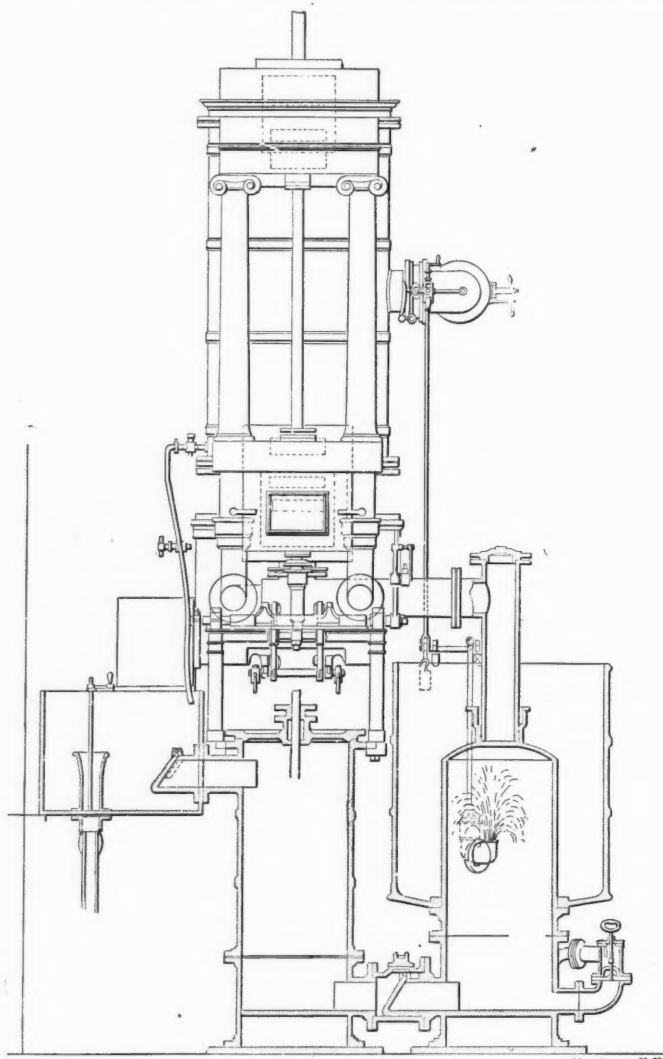


Fig. 5. Section through Condenser and Air Pump.

inside and so arranged as to give the flames a triple circulation.

It appears that this engine was run for the last time on June 9, 1859, and it was removed between 1900 and 1905 to give place to the Barbet and Hersent engines, but the building in which it was housed has been preserved.

According to a report of M. Usquin, rendered in 1837, this steam engine cost more than 3,000,000 francs (\$600,000), inclusive of the piping and the location of the same. It burned about 250 bushels of coal on a day's run and the cost of maintenance for the whole plant at Marly amounted to about 130,000 francs (\$26,000) per year. In this report the author pointed out the deplorable condition of the maintenance of the dam intended to keep the waters of the Seine in the bay of the machine. "The result is," he said, "that the water does not flow directly into the bay, so that, when it is low, only a small amount of water comes beneath the Marly

wheels and cannot give them the power that they were intended to have." It must not be forgotten, however, that these two wheels formed a supplementary machine, set up, according to this author, to be run during the construction of the steam engine, and that, under the circumstances, the manager of the works would have been in an awkward posi-

cost of water raised by the steam engine, and ended his work by demanding "the construction of a new hydraulic machine at Marly, according to present practice."

"This construction should be made with due attention to the desired solidity. Wheels should no longer be made of wood, but of iron, and they should not be carried upon wooden beams, but upon stone piers."

According to this report, dated in 1837, it appears that the work of this engine was even then unsatisfactory, and an estimate calling for an expenditure of 3,000,000 francs (\$600,000) was called for to replace it with other works, that were really not completed until more than twenty years afterward, when the engine was shut down and taken out of service.

G. L. F.

HIGH-LIFT TURBINE PUMPS—THEIR DESIGN AND EFFICIENCY.

Prof. J. R. Durley, in *Engineering Magazine*, July, 1906.

Under the above heading the author presents a valuable paper; the subject is treated in a clear and simple manner, the general principles and design of high-pressure centrifugal, or turbine pumps being fully exemplified by the aid of line drawings, while the appearance of the pumps of several of the best known makers is shown in numerous halftone illustrations. The paper is lengthy, but in the following abstract we have endeavored to give all the important features:

The centrifugal pump, in which there is only one moving part, the impeller, is the simplest form of pump from a mechanical point of view. Unfortunately, the commercial use of such pumps has hitherto only been possible under certain conditions, and for low heads, but a machine of the same simple construction, having only one moving part is now available for high heads in the shape of the high-lift turbine pump, which is practically a reversed inward flow turbine, but differing from the latter in the shape and curvature of the wheel vanes and guide blades.

The ordinary centrifugal pump has a low efficiency when working against high heads, due to the fact that with high speeds the frictional and eddy losses bear a very high proportion to the amount of useful work actually expended in pumping the water. A typical centrifugal pump of ordinary design, showing a maximum efficiency of say 70 per cent at 20 feet lift, will show only about 20 per cent at 80 feet. Efforts to utilize such centrifugal pumps for higher lifts by running two or more in series have not achieved commercial success.

The water streaming from the rim of the impeller of a centrifugal pump possesses kinetic energy, derived from the work expended in rotating the pump. If the vanes of the impeller were radial in an ideal frictionless centrifugal pump, and if the whole of the kinetic energy of the water at the rim of the impeller could be transformed into pressure energy, then the pressure against which such a pump could just deliver, would be calculated by the expression $v^2 \div 32.2$, where v is the linear velocity of the rim of the impeller in feet per second.

If we take the case of water delivered from an ordinary centrifugal pump with a velocity of 10 feet per second in the discharge pipe, under 50 feet head, the total energy possessed by each pound of water delivered is 51.55 foot-pounds, of which 1.55 foot-pounds is kinetic energy and 50 foot-pounds is pressure energy. An ideally perfect pump would attain this result by the expenditure of 51.55 foot-pounds of work per pound of water pumped, and the impeller would have a peripheral velocity of about 41 feet per second. An actual pump, however, working under these conditions, and having an efficiency of perhaps 50 per cent would require the expenditure of twice as much work per pound of water pumped, and the impeller would have to be driven at a considerably higher speed, depending on the design, probably about 60 feet per second. To judge of the performance of a centrifugal pump, under any given conditions, it is necessary to know two things: the efficiency and the "manometric coefficient," which is the ratio of actual pressure in the pump discharge to the pressure which would be attained in an ideally perfect pump with the same peripheral velocity of impeller. Curves of these two quantities, plotted with regard to the amount of

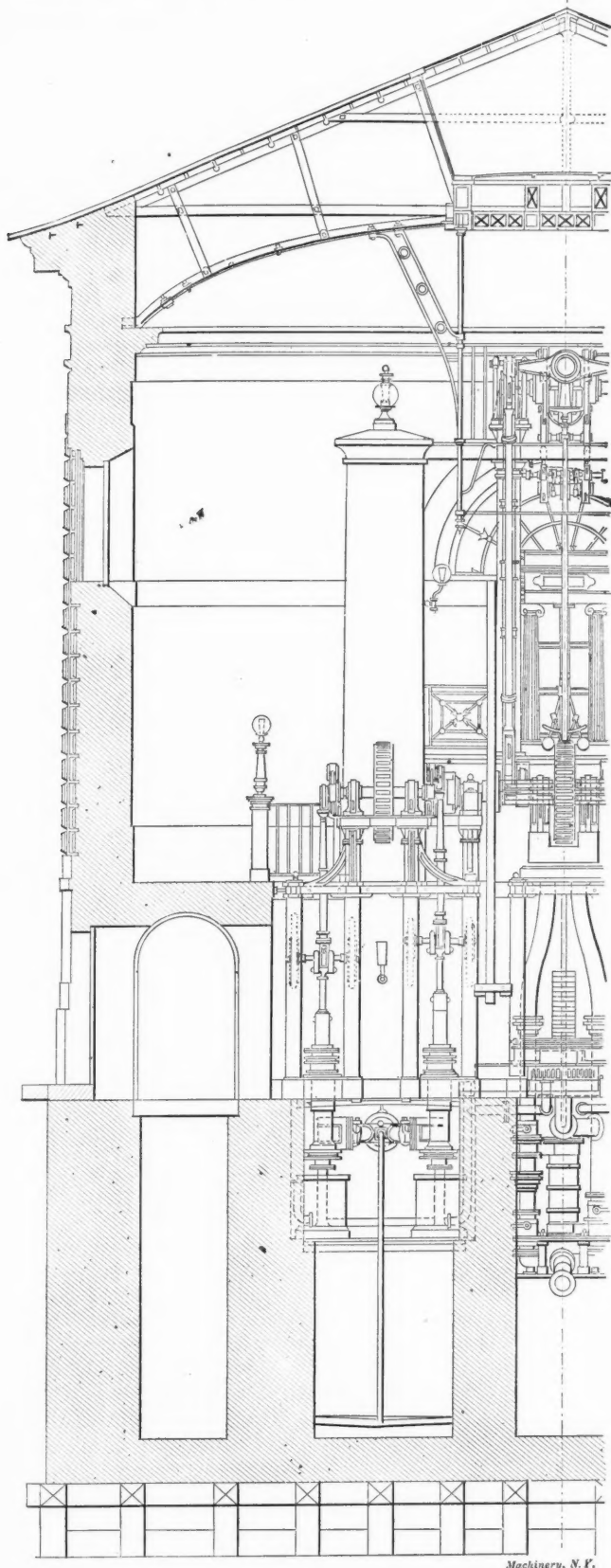


Fig. 6. Details of Building and Arrangement of Pump Cylinders.

tion had he asked from the Civil List the funds needed to repair the dam, which was considered useless after the steam engine had been completed.

In this interesting report, M. Usquin called attention to the irregularity of the service of the water pools as well as the unhealthfulness of the water itself. He also emphasized the

water discharged will give all necessary information as to the performance of a pump at a given speed throughout its whole range, from the point at which the discharge is zero and the pressure large, to the point at which the pressure is zero and the discharge a maximum. The forms of these curves are affected considerably by the shape of the vanes of the impeller, and can be varied by a skillful designer to suit special conditions. Fig. 1 shows the efficiency and pressure curves for an 8-inch low-lift centrifugal pump tested by Messrs. Denton and Kent. The pump was designed for a delivery of 1,200 U. S. gallons per minute against 45 feet head when running at 2,000 revolutions per minute, and it will be seen that while the maximum efficiency of the pump occurs at very

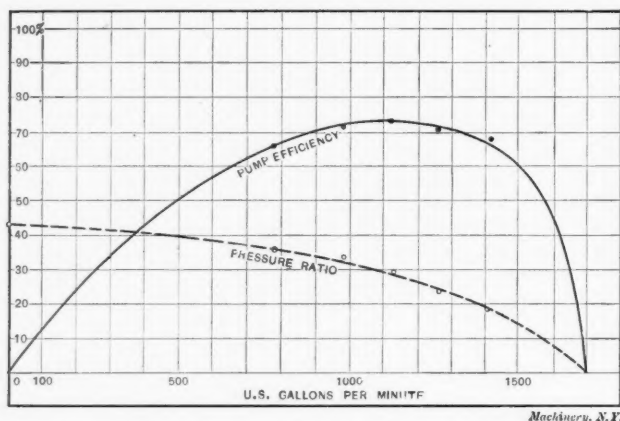


Fig. 1. Efficiency and Pressure Curves for Low-lift Centrifugal Pump.

nearly the designed rate of discharge, it falls off rapidly when delivering larger quantities of water. The curves of Fig. 1 correspond to the forms usually shown by pumps in which the vanes are curved backwards at the tip, and such impellers may be used in cases where a pump has to work with fair efficiency at constant speed while the head is varied over a considerable range. It is possible by modifying the shape of the vanes, making them nearly radial, to obtain a pressure-coefficient curve approximately horizontal for a considerable variation of the amount of water pumped; indicating that with such an impeller, when the demand for water is changed, the pressure will remain nearly constant while the pump runs at constant speed. Such a design is suitable for a pump supplying a boiler-feed system. By still further changes in the design of the vanes, we are even able to obtain a pump in which the head increases as the delivery is increased.

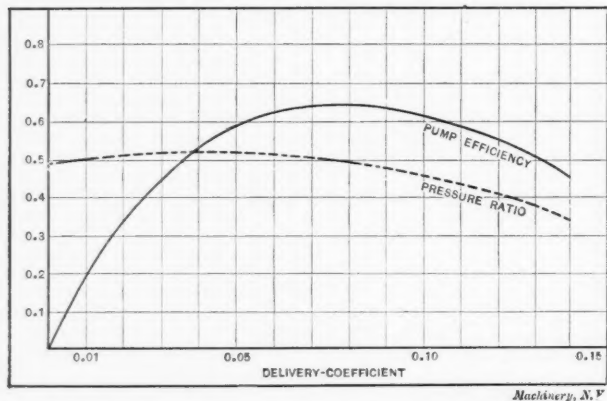


Fig. 2. Efficiency and Pressure Curve for a Four-stage Turbine Pump.

Such curves as those just given may be called the characteristic curves of the pump, although they apply only to the particular pump and speed for which they are drawn. M. Rateau has shown that instead of measuring the quantity of water along the base line of such curves, a quantity he calls the "delivery coefficient" may be used with advantage. This coefficient is numerically equal to the amount of water discharged, divided by the peripheral velocity of the impeller, and by the square of the radius of the latter. A given characteristic curve plotted in this way becomes applicable to pumps of all sizes of the same design, the correct speed being used for each size. This result follows because the quantity delivered by an ideal centrifugal pump varies as the peripheral

velocity of the impeller, and as the square of the linear dimensions of the pump. A characteristic curve of this kind, for a four-stage pump is given in Fig. 2. The improvement which differentiates the high-lift centrifugal pump from the ordinary low-lift centrifugal pump, consists in the addition, outside of the impeller, of a "diffusion ring" containing stationary guide blades (Fig. 4). By means of these blades the water leaving the impeller is smoothly conveyed to the annular discharge chamber, and its velocity head is more effectually converted into pressure head. The high peripheral velocities of impeller necessary for high heads can then be employed without a corresponding diminution of efficiency. The practical result obtained by this method of construction is that pumps having a simple impeller can deal with heads exceeding 100 feet with good economy; the efficiency possible depends on the design of the pump, and especially on the relation between the diameter of impeller, the required number of revolutions, and the amount of water to be pumped. By placing turbine pumps in series a multiple-stage pump is obtained, and it is possible to pump against greater heads; under these conditions a pump efficiency of over 70 per cent is frequently attained. The greatest head dealt with commercially up to the present time appears to be about 1,500 feet, but for such a lift the usual practice would be to use two or more multiple-stage pumps in series. The usual head for a single multiple-stage pump is from 300 to 600 feet.

It must not be supposed that such results as those just stated have been attained without much trouble, and overcom-

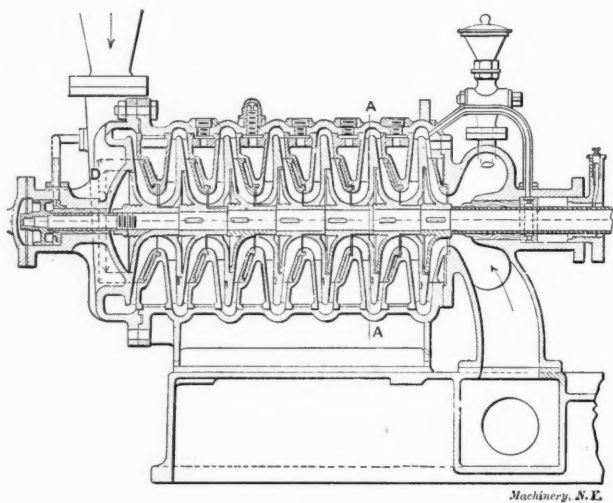


Fig. 3. Seven-stage Pump, Piston Balanced.

ing many practical difficulties. One of the first difficulties to make itself felt was end thrust on the pump shaft. In a single-stage turbine pump the water at entrance to the impeller is flowing parallel to the axis of the shaft, and in being deflected so as to move in a radial direction it exerts a considerable thrust along the shaft. The simplest way of avoiding this thrust is by using an impeller that takes water on both sides, but when a number of impellers are placed in series on the same shaft, as in Fig. 3, this construction cannot be used. In Fig. 3 the impellers take water on one side only and the end thrust is taken care of by suitably proportioning the areas of the two sides of each impeller, and by the use of a rotating balance piston, one side of which is exposed to the pressure in the discharge pipe. It will be noticed that in this pump the impellers have a larger diameter on the inlet side than on the side nearest to the pump discharge; these areas are chosen so that the difference of the total pressures on the two sides of each impeller balances its own end thrust as nearly as possible.

One of the first multiple-stage pumps adopted an arrangement in which the impellers were placed in pairs back to back (Fig. 5). In the Buffalo pump, Fig. 6, we have a somewhat similar design, in which the spaces between the outer faces of the impellers and the adjoining casings are used as pressure chambers. Packing rings are fitted, so as to prevent leakage from the delivery to the suction side, and the areas of the two pressure chambers of each impeller are arranged

so as to make the total difference in axial pressure approximately equal to the thrust due to the difference of inlet opening in the two impellers of the pair. In this way each pair of impellers is balanced perfectly.

Another method which can be employed to balance a single-suction impeller involves the use of radial vanes formed on the outside surfaces of the impeller, and therefore rotating the water in the pressure chambers. By proportioning correctly the length and clearance of these vanes, the pressures existing in the various pressure chambers while the pump is running can be brought to the amounts required for balance. These so-called "triple-vanes" increase slightly the power

tion of the exposed portions of the shaft from corrosion; the prevention of leakage from one stage to the next, by fitting brass packing rings; and the arrangement of the impellers and division plates so as to admit of easy assembly and removal without interfering with permanent pipe joints or connections. The form of the guide passages in the diffusion ring, and the shape of the ports or passages leading from one stage to the suction of the next, have considerable effect on the efficiency of the pump.

The results attained by the modern high-lift centrifugal pump may be stated generally as follows; an efficiency in most cases of from 70 per cent to 75 per cent can be obtained, and

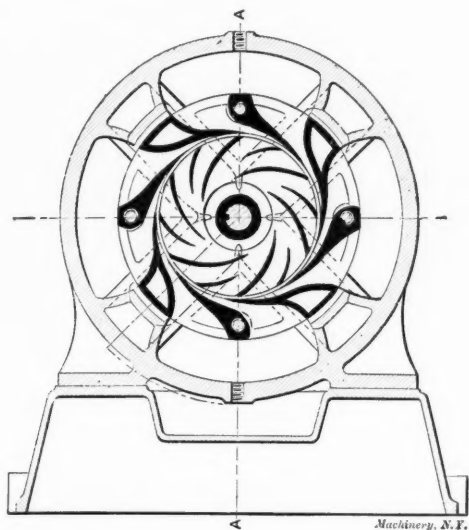


Fig. 4. Characteristic Arrangement of Blades in a Turbine Pump.

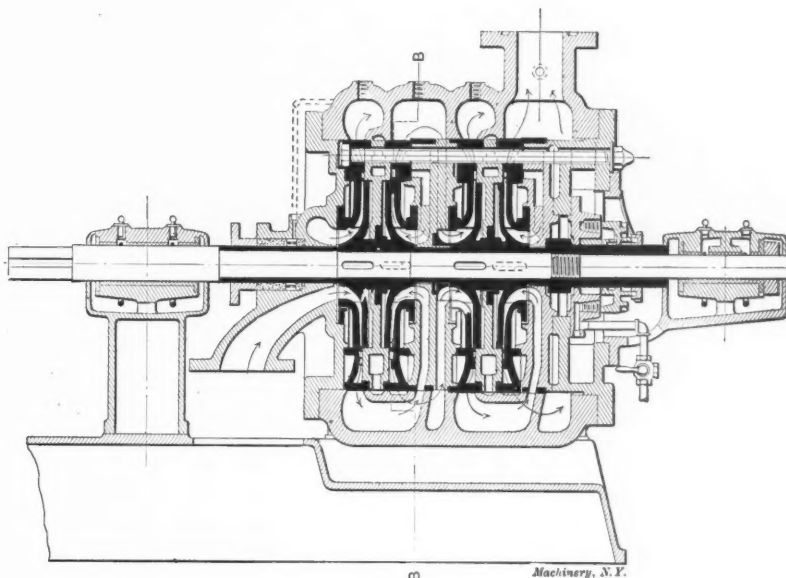


Fig. 6. Longitudinal Section of Pump shown in Fig. 4.

required for driving the impeller, but it is questionable whether the power wasted in the thrust bearing of an imperfectly balanced pump would not be greater than any loss due to the triple vanes.

The construction of the main bearings and stuffing boxes in a high-lift turbine pump has to be carefully considered. It is good practice to arrange the design so that the bearings and stuffing boxes are quite separate; in this way the weight of the shaft and its impellers is carried by easily accessible bearings, no grit from the water can get to the journals, and the stuffing boxes are able to perform their own duty without

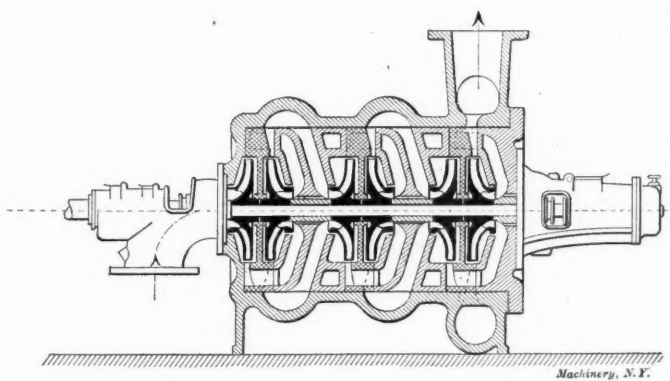


Fig. 5. A Balanced Multi-stage Pump.

taking any load. The tightness of the stuffing box on the suction side of the pump is specially important, and this box is generally provided with a water supply, so that any leakage into the pump will be of water and not air. Fig. 6 shows an arrangement of double stuffing box for the suction side fitted with such a water-logging attachment. A comparatively small air leak on the suction side will suffice to prevent the pump from working at all. The pump may be constructed so that water leaking from the last pressure chamber is used to cool the bearings.

Other points requiring attention in design are, the protec-

tion of the exposed portions of the shaft from corrosion; the prevention of leakage from one stage to the next, by fitting brass packing rings; and the arrangement of the impellers and division plates so as to admit of easy assembly and removal without interfering with permanent pipe joints or connections. The form of the guide passages in the diffusion ring, and the shape of the ports or passages leading from one stage to the suction of the next, have considerable effect on the efficiency of the pump.

The results attained by the modern high-lift centrifugal pump may be stated generally as follows; an efficiency in most cases of from 70 per cent to 75 per cent can be obtained, and

under suitable conditions this may even reach 80 per cent on trial. The pumps can be so proportioned as to give a fairly constant efficiency over a considerable range of discharge. When running light, the power absorbed is generally from 25 to 40 per cent (see Fig. 17) of that at the rated output of the pump.

In good practice the head to be overcome by each stage is from 100 to 200 feet. When the head is more than 200 feet it is difficult to obtain high efficiency, owing to the high velocity of the water. The maximum speed of the impeller is limited by the rapidity with which water can flow into the suction. The greatest number of stages now used is eight, but there seems to be no reason why the number could not be increased.

It is probable that further progress will soon enable efficiencies corresponding with the best water turbines to be obtained. Tests of turbine pumps after some years' work have shown that when properly constructed there is little falling off of efficiency on account of wear and corrosion. Turbine pumps can maintain their original efficiency much better than is usual with large piston pumps.

Turbine pumps are lighter and smaller than reciprocating pumps. A reciprocating pump driven by a 300-horsepower motor and occupying a floor space of 50 x 25 feet was replaced by a turbine pump driven by a 500-horsepower motor that occupied a floor space of 31 feet 6 inches by 8 feet 6 inches; and the weight of the latter is about one-half that of the former. The reciprocating pump delivered 4,500,000 gallons per twenty-four hours, and the turbine pump 6,500,000, the head being 300 feet.

High-lift turbine pumps of the largest size are now being employed to supply water for cities and towns. They are also used extensively in mines. In the latter service they are not only employed as permanently located drainage pumps, placed conveniently in chambers excavated near the bottom of the shaft, but also as sinking pumps, in which case they are suspended in the shaft in suitable frames; and, owing to their small size, they leave ample room for the passage of the

cages or tubs of the hoisting apparatus, even when of considerable power.

High-lift pumps are finding a wide application for purposes of fire protection, both in factories and cities. A fire protection system now being installed in Toronto comprises two two-stage Worthington pumps, each directly connected with a steam turbine of 1,000 horsepower capacity.

In Europe high-lift pumps driven by electric motors have been used as portable fire engines with considerable success. For elevator service these pumps give good results if arranged to be controlled electrically or mechanically, so as to vary the discharge automatically in conformity with the demands of the elevator.

A number of successful pumping installations have been carried out in which a high-lift pump has been driven directly by a water turbine. Such a turbo-pump, as built for mine service in Central America, consists of a four-stage Rateau pump having impellers $9\frac{1}{2}$ inches in diameter, and driven at 2,200 revolutions per minute by a reaction turbine placed within the same casing. The 120-horsepower turbine, taking its water under a head of 520 feet, has a single wheel $11\frac{3}{4}$

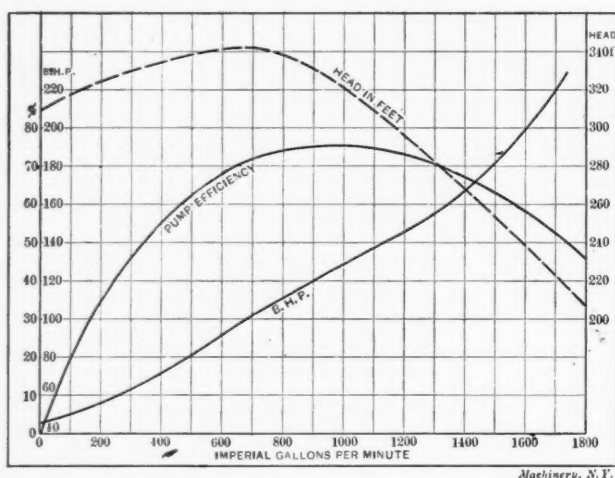


Fig. 7. Characteristic Curves from a Turbine Pump Test.

inches in diameter, and delivers the water it has used into the discharge pipe of the pump; the pump works under a head of 390 feet and delivers 400 imperial gallons per minute. The combined efficiency of the pump and turbine is 48 per cent.

High-lift centrifugal pumps directly connected to steam turbines are used in many cases and have shown good results as far as steam consumption is concerned. Under favorable conditions a consumption of 22.6 pounds of saturated steam per pump horsepower per hour has been shown on a seven-stage pump delivering 900 imperial gallons per minute under 1,180-foot head, and taking about 320 horsepower.

Although high-lift centrifugal pumps have been on the market for only about nine years in Europe, and four years in America, their use has become widely extended. Such pumps are now commercially available for almost any service, so long as the amount of water to be dealt with is not too small in comparison with the head at which it is to be delivered.

W. B., JR.

* * *

The Anglegraph is the name of a device for draftsmen manufactured by the Cassady-Fairbanks Mfg. Co., 6106 La Salle St., Chicago, Ill. It consists of a triangular piece of sheet metal, nicely finished and nickel plated, in which is drilled a series of holes, so spaced that a variety of geometrical figures can be constructed by its aid. By placing a tack or pin through one of the holes as a pivot, circles of different diameters can be drawn by means of a lead pencil, the point of which is inserted in any one of the holes desired. Certain of the holes are numbered and by the aid of directions given they may be used in connection with a pencil point to divide a circle into any number of equal parts up to 16 and by the use of the several gages of the instrument, in connection with the numbered holes, geometrical figures of complicated construction can be drawn.

DYNAMO AND MOTOR TROUBLES.

WITH CHART WHICH APPEARS IN THE SUPPLEMENT.

F. W. S.

A number of small volumes have been written on the care of electrical machinery, particularly dynamos and motors. Most of these books are very useful in assisting the operator in the proper maintenance of the apparatus and the discovery of the causes of faults and breaks which are constantly liable to occur. Almost any given symptom of distress in a dynamo or motor, however, may be due to a number of different causes. This fact, together with the lack of method in the arrangement for some of the books dealing with the subject, often handicaps the beginner in locating the particular fault to which any given trouble is due.

Roughly speaking the various diseases to which dynamos and motors are subject may be placed in six general classes. First, sparking of the brushes; second, heating of the parts; third, noises; fourth, variations in speed; fifth, miscellaneous derangements peculiar to motors as distinguished from dynamos; sixth, miscellaneous derangements peculiar to dynamos and generators as distinguished from motors. It is again possible to divide each of these major symptomatic indications into minor ones. The sparking of the brushes, for instance, may be due, first, to faults of the brushes; second, to faults of the commutator; third, to excessive currents in the armature; fourth, to faults in the armature. Each of these divisions may be again subdivided and an appropriate individual remedy indicated.

To make this clearer I have prepared a chart showing the arrangement I have in mind. This chart appears in the Supplement and to illustrate its use we will suppose, for instance, that the armature of a motor becomes dangerously hot after running for a time. The chart is consulted and under the heading of "heating of parts" the sub-head "armature" is found. There are seven different causes given here for heating of the armature. It may be due to overload of the motor, to a short circuit due to carbon dust, etc., on the commutator bars, or it may be caused by a broken circuit, a cross connection, moisture in the coils, eddy-currents in the core, or heat conveyed from a hot box or journals through the shaft. Each of these seven causes may be investigated in turn. For instance, it may be found that the armature coil is warmer than the winding which surrounds it. If this is the case, the trouble is due to eddy-currents in the core, or to heat conducted through the shaft from a hot box. If the latter the shaft will of course be hotter than the armature, and the bearings still hotter than the shaft. If the trouble is due to eddy-currents the armature will be found to be made of solid metal, or to be not sufficiently laminated. In either case the trouble is readily discovered.

There are two advantages in using a chart of this kind. In the case of trouble with a motor or dynamo, a text book is generally too voluminous to be easily used and, quite likely, is not well enough arranged to permit a quick diagnosis. Then again, after a person has carefully read over such a work several times, he will still find the chart very acceptable, as a guide which will show him where to look and what to do—something that can be glanced over quickly and can be readily found, which will outline the proper course to pursue. The trained mind will then quickly recall from the book the details of the proper method of procedure.

* * *

About 40,000 tons of tin are consumed annually in the United States, about half of which is used in the manufacture of tin plates and solder. It is interesting to note that improvements in the manufacture of cans for fruit, vegetables, meats, etc., has decreased nearly one-half the amount of solder required per can, thus illustrating how machinery may in some cases work out an economy of the use of materials as well as a saving of labor. The annual consumption of tin is about 90,000 tons for the whole world and the scarcity of the product is constantly forcing the price upward. A tin mine would be one of the most profitable holdings that a man could own, the price being about 38 cents a pound.

LEATHER MEASURING MACHINE.

H. A. DUDGEON.

The following description of what is really an area measuring machine may be of interest to many of the readers of this journal as it embraces several novel mechanical ideas in its construction, the machine being designed to overcome the objections met with in all previously designed machines for a similar purpose.

It is first perhaps necessary to explain that leather from which the uppers of boots and shoes are cut is sold by super-

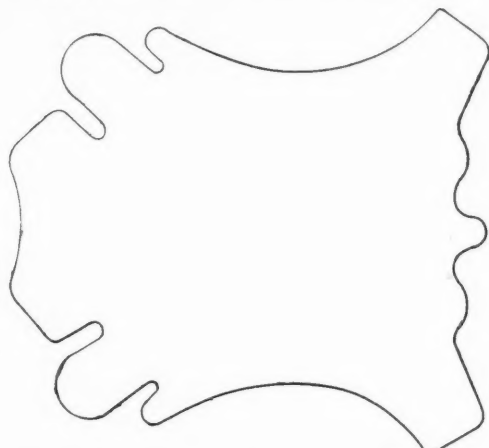


Fig. 1. Sketch showing Typical Outline of Hide.

ficial measure, or so much per square foot and owing to the irregularity of the outline of the skins themselves, which is something like Fig. 1, it is very difficult if not impossible to obtain an exact measurement and so the near approach to this has to suffice; for whilst being very close to the actual measurement the results obtained are more or less only an approximation and, whilst the machine about to be described is no exception to the general run of machines in that respect, it perhaps approaches being exact more nearly than the others.

would be much easier, in fact would hardly need a machine at all but such, however, is not the case, and as in an engine indicator diagram the surface must be divided into imaginary parallel strips and the mean length or height of each strip measured by providing a measuring wheel for each strip, the results being added together for a final result. Now, if, instead of passing the measuring wheels over the surface the surface is made to pass under the wheels the result is the same, and in the machine this is done, the following description showing how it is carried out in practice and the means adopted for recording the revolutions of the measuring wheels and adding them together.

Referring to Figs. 2 and 3, *AA* are the measuring wheels placed equidistant apart and carried by the arms *BB*, being placed directly above the feed-roller, *C*, which is belt driven. On one side of each wheel is a small boss, and attached to this and wound once around the boss is a fine cord, *D*, the other end of the cord being attached to a movable weight, *E*, there being as many cords and weights as there are wheels. These weights are carried on inclined arms, *F*, secured to a shaft, *G*, the shaft being carried on centers, a ball race being formed in the end of the shaft, the balls resting on the centers, thereby reducing the friction to a minimum. To one end of the shaft *G* is secured a lever, *H*, the outer end of the lever being supported by the coil spring, *J*. In the normal position the weights, *E*, are nearly at the bottom of the inclined arms, and so near the center of the shaft, in that position exerting a certain pressure tending to revolve the shaft *G* about its axis; this is resisted by means of the lever *H* and spring *J*. If one or more of the weights are moved up the inclined arms by any means a greater turning tendency is imparted to the shaft and a greater deflection of the spring takes place.

This then is what happens in the machine: The leather is placed on the table *K* and fed between the feed roller *C* and the measuring wheels, *A*, some of the latter being caused to revolve, the number in action being governed by the width from left to right of the skin, each revolving just so much, according to the length of the surface passed under them.

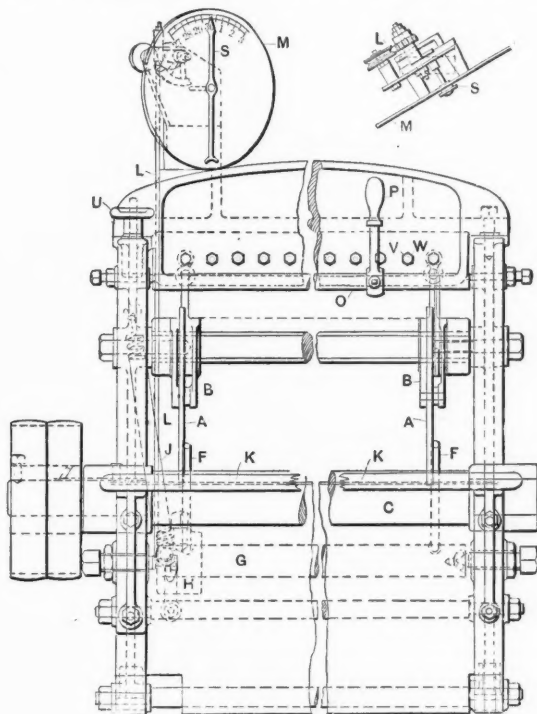


Fig. 2. Front View of Leather Measuring Machine.

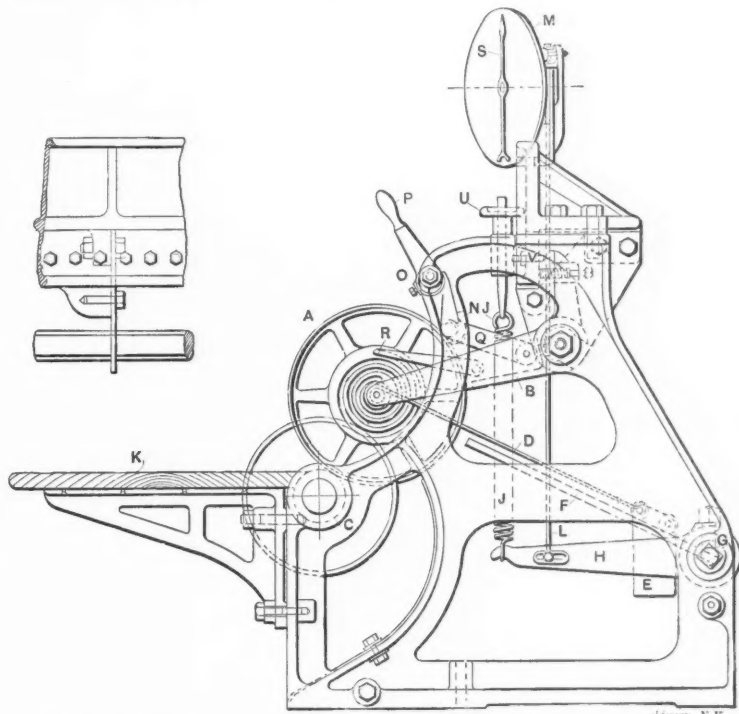


Fig. 3. Side View, showing Measuring Wheels and Weighing Mechanism.

To put it in simple language the underlying principle of the machine is this: If a wheel of known circumference is traveled along a surface it is an easy matter, by counting its revolutions to calculate the length of surface passed over. If such a wheel were to account for a surface between lines parallel to the motion of the wheel and of known width, and the ends of the surface were straight and square with the sides then the length multiplied by the width gives the area. Now if the skins to be measured were of such a shape the problem

And this, by means of the cords draws the weights up the inclined arms a certain definite distance, their combined action thereby deflecting the spring *J* through the shaft *G* and lever *H* a predetermined amount proportional to the position of the weights. It is an easy matter to record the movement of the shaft. This is done by means of the rod *L* attached to the lever *H*. At the top of the rod is a rack which meshes with suitable gearing actuating the hand *S*. This hand moves in front of the dial *M* placed in a convenient position on the

machine, the graduations giving a direct reading in square feet.

A brake *N* is provided for each measuring wheel to retain it in position until the reading has been taken, the brakes all being released simultaneously by means of the eccentric shaft *O* and handle *P*, the shaft in its normal position being just clear of the extension on the brake lever *Q* when the brake is resting on the wheel. By turning the eccentric shaft, all the brakes are lifted from the wheels together, and the weights travel down the inclines into their normal position. To insure the weights stopping in their proper positions at the bottom of the inclined arms a scroll is formed on the face of each measuring wheel in which a small projection on the end of the lever *R* lies. As the measuring wheel revolves forward this projection follows the path of the scroll, and when the wheel revolves in the reverse direction the end of the scroll strikes the projection on the lever.

An interesting feature in the machine is the method adopted to prevent registering *surface* when only *thickness* has passed through. The measuring of this can be best shown by means of a diagram. In Fig. 4 let *A* represent the measuring wheel, *C* the feed roller, *K* the table, and *N* the brake. Now if a solid represented as an end view by the triangle *T* be passed through the machine it is evident that the measuring wheel

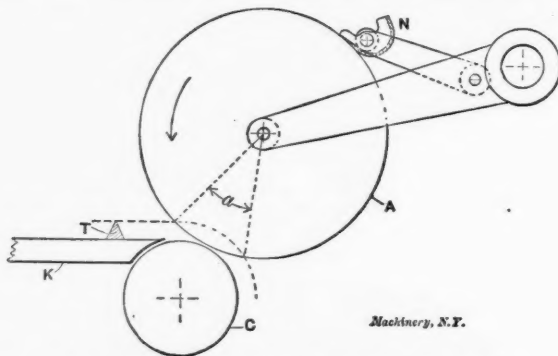


Fig. 4. Compensating Device for Thickness of Hide.

A will rotate a certain amount equal to the angle α , although obviously the line representing the apex of the triangle has no area.

Similarly any substance passed through the machine will move the measuring wheel through a similar angle proportional to the thickness of the substance *in addition to the surface of the substance* and unless provision is made this angle will be added to the reading, giving an incorrect result which, considering that on an average 30 wheels are in action on each skin measured, is a serious matter. To overcome this the brake was made of such a form that for part of a revolution of the measuring wheel the brake turns with it, the amount being calculated from the angle through which the wheel turns for an average thickness of leather. Any further movement of the measuring wheel in a forward direction shown by the arrow causes the brake to slip but as soon as each wheel ceases measuring the part of the skin passing under it, the weight on the inclined arm revolves the wheel in the reverse direction just the predetermined amount, this reverse movement of the weights being therefore deducted automatically from the reading.

The nut *U* is for adjusting the indicator to zero when first setting up the machine and the screws *V* are used for setting the measuring wheels *A* just clear of the feed roller, being locked by means of the nuts *W*.

* * *

A motor-driven rail mill is now in operation at the Edgar Thompson plant of the Carnegie Steel Co. at Bessemer, Pa. It is equipped with two 1,500-horsepower, 30-pole, 220-volt, direct-current motors overcompounded 15 per cent, which operate at from 100 to 125 R. P. M. Each motor carries a 125,000-pound cast-steel segmental flywheel which frees the motor from the extreme shocks of rolling. The power delivered by each motor ranges from 950 to 1,450 horsepower in rolling rails with occasional jumps to 1,700 horsepower, while the friction load on the mill running light is about 500 horsepower.—*Engineering Record*.

NEW DUTY RECORD ESTABLISHED FOR THE PUMPING ENGINE.

Tests which were made upon a twenty-million-gallon Allis-Chalmers triple expansion pumping engine at the Bissell's Point Station of the St. Louis Water Works in the latter part of February, 1906, determined the production of an indicated horsepower per hour on an average consumption of 10.59 pounds of dry saturated steam. The average heat supply was at the rate of 201.39 B. T. U. per minute horse power, giving a thermal efficiency of 21.06 per cent. The mechanical efficiency was 97.4 per cent; the duty per 1,000 pounds of steam 181,068,605 foot pounds, and per million British thermal units 158,581,000 foot pounds. The guaranteed duty was 135,000,000 with a bonus of one thousand dollars per million foot pounds, so that the engine earned its builders \$46,068.61 above the contract price.

The engine tested is the last of a series of three installed at the above station, and is of the vertical triple-expansion, self-contained type, with single-acting outside-packed plungers located directly under each cylinder. The lower bed-plates rest on solid rock foundations; the main pillow block bed plates are supported upon cast iron frames resting on the lower bed plates and the cylinders are supported by frame of the "A" pattern.

The cylinders are 34, 62 and 94 by 6 feet stroke with water plungers 33 $\frac{3}{4}$ inches in diameter. Before the official test the plungers were carefully calibrated by micrometer calipers checked by steel tape measurement of circumferences. The strokes of all plungers were also carefully measured. The pump valves were inspected and found to be tight under full pressure.

The specifications and contract required that, "In order to determine the amount of steam used by the engine, the water will be weighed twice; that is, the feed water going into the boiler and the condensed steam coming out of the engine." Accordingly, the condensation from the condenser, jackets, receivers and drips from stuffing boxes was weighed as received from the engine and delivered in the boiler room, and was found to check by 0.12 of one per cent. This being a reasonable check the water as weighed in the engine room was taken as the steam used.

The gallons of water pumped in twenty-four hours was 20,070,590 against a head of 100.021 pounds at the discharge pipe, the contract requiring 100 pounds pressure. The head in the discharge main was read by means of a mercury column and the suction head by a float gage. The plunger leakage was weighed and found to be 16.77 gallons per hour. Steam of 140 pounds pressure at the throttle was furnished containing 0.13 per cent moisture.

RESULTS OF DUTY TEST.

Duration of test.....	24 hours
Diameter of cylinders.....	34, 62 and 94 inches
Stroke of engine.....	72 inches
Diameter of plungers.....	33 $\frac{3}{4}$ inches
Average steam pressure at engine.....	140.24 pounds
Average first receiver pressure.....	26.36 pounds
Average second receiver pressure.....	2.77 pounds
Average vacuum pressure by cards.....	13.21 pounds
Average barometer pressure.....	14.46 pounds
Average net head pumped against.....	238.2323 feet
Average revolutions per minute.....	16.539
Piston speed per minute.....	198.44 feet
Total water pumped.....	20,070,690 gallons
Total water received from engine.....	220,129 pounds
Average moisture in steam.....	0.13 per cent
Indicated horse power.....	865.22 horse power
Delivered horse power.....	842.69 horse power
Per cent friction.....	2.60 per cent
Average moist steam per I. H. P. per hour.....	10.60 pounds
Average dry steam per I. H. P. per hour.....	10.59 pounds
Average B. T. U. per I. H. P. per minute.....	201.39 B. T. U.
Mechanical efficiency.....	97.4 per cent
Duty per 1,000 pounds of steam.....	181,068,605 foot pounds
Duty per 1,000,000 B. T. U.....	158,581,000 foot pounds
Thermal efficiency.....	21.06 per cent

* * *

The yearly index for MACHINERY is now ready and will be sent to all subscribers upon request.

THE COST OF RUNNING MACHINERY.

D. C. EGGLESTON.

The cost of running machinery is such an important subject in factory economy that a discussion of the items making up the "Machine Expense" may be of interest to readers of MACHINERY. Cost accountants have used the term "Machine Expense" to include the total charges incurred in running the machine equipment of a factory. It costs money to maintain a machine, repair it, pay taxes on it, rent floor space for it and so on, as well as it does an operator to live, and oftentimes the machine is the more expensive of the two. The "Machine Expense" is always more difficult to figure than the labor expense and more economies can usually be made by a study of it. The importance of studying this subject will be realized when it is known that the "Machine Expense" in one factory was 70 per cent of the cost of labor on jobs passing through all departments. The more expensive and intricate the machine is the more the "Machine Expense" will be, but this does not vary with labor. One operator will oftentimes tend a half-dozen automatic screw machines, and it is easily seen that the "Machine Expense" is greater in proportion to the cost of labor than if he were tending only one drill press. This variation in the cost of maintaining the machine equipment of a factory with the labor is one reason why the percentage plan of figuring costs leads to erroneous results whenever the machines in a factory are of different types.

As soon as a machine is installed certain expenses called fixed charges begin. A machine which has been used cannot be sold for as much as it cost. Not only has the wear and tear on it made it less valuable, but perhaps the manufacturer can supply a newer and more efficient type, which makes the old machine less valuable. In short, longevity and obsolescence must be considered in fixing the rate for depreciation. The engineer must use his best judgment in estimating the probable life of a machine and then enough money must be set aside each year from the profits if put at compound interest to redeem the machine when the time comes for replacing it. As high as 15 per cent of the face value is oftentimes written off, but it varies so much that the best judgment must be exercised in all cases.

Insurance must be taken after deducting the reserve for depreciation. Taxes are also an element of expense and belong to the fixed charges account. In a Pratt & Whitney No. 1½ hand screw machine costing \$731.25 the fixed charges amounted to \$66.81 a year.

The cost for power is an important item in most machinery and the exact amount used should be found by metering it. In estimating the cost of power all fuel, oil, wages of firemen and sundry expenses should be included. In the machine mentioned the yearly charges for power were \$142.90.

The machine occupies floor space in the building and should bear its share of the expense incurred in maintaining the building in an efficient state for conducting the work of the factory. The best way is to charge all repairs, changes, fixed charges and expenses for cleaning to rent expense and then prorate this according to the floor space occupied, making the machinery bear its proper part. In the machine previously used for illustration the rent expense amounted to \$41.90 a year.

All administration expense, including salaries of superintendent, foremen, clerks, traveling, entertainment, stationary, and so on should be summarized and prorated according to the number of productive employees. If one employee works at a hand screw machine the administration expense which must be included in the cost of running that machine is the amount allotted to one employee. If two employees work at a multiple drill press the administration expense is double that for one employee, and so on.

All repairs, changes and expense incurred in behalf of the tool equipment, salaries of tool inspectors, tool clerks, and fixed charges on small tools should be distributed among the different machines by estimate and analysis. It will be found that tool expense is the largest item of "Machine Expense" and a careful study of the items making it up will suggest valuable economies.

Sundry expense is designed to cover all items not charge-

able to other branches of "Machine Expense" such as oils, chemicals, water other than for boilers, defective work and stationary. Although this expense is only about one-fifth as much as tools expense it ought to be divided among the various machines by estimate so that each machine will bear its proper share.

For purposes of cost accounting it is necessary to include the cost of running non-productive machinery in the cost of productive machinery. Thus the cost of running a filing machine which is used for filing the saws for eight saw tables would be assessed equally against the saw tables.

The sum of the fixed charges, power, rent, tool and sundry expense, together with the non-productive machinery assessed against a machine, is the total cost of running it. If the total cost for running it one year be divided by the yearly number of working hours the hourly machine rate can be found. Then this "Machine expense" can be charged on the job ticket the same as the operator's time. If the cost of material, including material expense, is added to labor and "Machine Expense," we have the total cost to make an article. If the machines are grouped together in classes, it is not a very difficult task to estimate the rates, and the accuracy of figuring costs where this system is employed justifies the trouble incurred in accurately finding the cost of running machinery.

* * *

CHINESE RAILROADS AND CHINESE GRAVES.

Speaking of the difficulties experienced by railway builders in China in pacifying the descendants of the numberless dead, disturbed by the building of the road, Mr. Ashmead, head engineer of the Canton-Hankow railway, in the course of an interesting contribution to the *Engineering News* states that, while the prices of graves are variable, the average is 4 taels (about \$2.80) per coffin. There being no grave yards in China, as with us, and the location of each separate coffin having been chosen previously by geomancer, according to immemorial Chinese custom, it requires much tact on the part of the native and foreign officials of the road to accomplish the removal of coffins from the right of way, as graves cover much of the ground, being thickly scattered over the lowland, as well as on the hills and mountains. This observation as to the vast number of graves met with in China calls to mind a remark made by a gentleman who had lived for some years in that country to the effect that the Chinaman has carried out to its logical extreme the idea of the reduction of waste. Forced as he is to live in a country so thickly populated that its inhabitants are barely able to find food for themselves, great effort is made to protect the constantly worked soil from loss of productiveness. Not only is every particle of garbage and household waste from each village collected and returned to the adjacent land to refertilize it for next year's crops, but the Chinaman himself, when his end comes, feels that he also must return to the soil from which he has drawn his sustenance. His body is therefore carried outside his native village and buried just a few inches below the surface, where the fertilizing properties which he has drawn from the food during life will be available for the plants growing around him, destined for the future support of his friends and neighbors. How much this idea of returning to the soil everything he has taken from it is accountable for the Chinaman's desire to be buried in his own land, it is hard to say, but his careful economy of phosphates and nitrates is in sharp contrast with the customs of the inhabitants of Europe and America, whose rivers, as Huxley, we believe it was, pointed out many years ago, are constantly carrying to the ocean untold treasures of fertilizing material.

* * *

The danger attending the pouring of melted lead into a cavity without making sure that the hole is perfectly dry is illustrated by an accident befalling a Herkimer, N. Y., man some weeks ago. He poured some hot lead into a hole in the cement floor for the purpose of filling around a pipe and it turned out that there was some water in the hole. The melted lead was thrown out with tremendous force, striking him in the face and badly burning him in several places. Fortunately, eyeglasses saved his sight.

DOWEL MAKING MACHINE.

An interesting woodworking machine was described, in principle, several months ago in *Wood Craft*, being a dowel making machine built by W. C. Farnum, Arlington, Vt. The machine makes the dowels from the log, the logs being first cut up into bolts of the length of the finished dowels. These bolts are then mounted on the machine and the dowels sawed out round and to finish size by means of a tubular saw. During this latter operation the dowels are cut out of the bolt from positions corresponding to those of the cells in a honeycomb; that is, in rows which cut each other at an angle of sixty degrees. It is asserted that by this method a saving of about one-third is obtained over the old process, both in material and time.

Fig. 1 is a plan view showing the operation of the tubular saw and shaper head cutting cylinders out of the block of wood, or, in other words, milling dowels out of bolts. Fig. 2 is a perspective view of the shaper head. Fig. 3 is a perspective view of the tubular saw and a portion of its spindle.

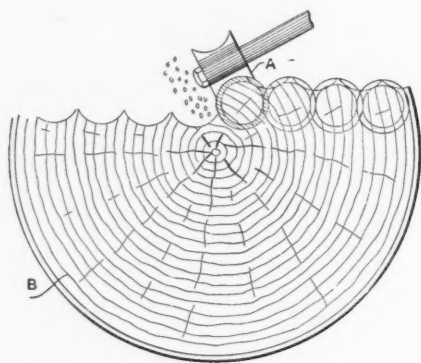


Fig. 1



Fig. 2



Fig. 3

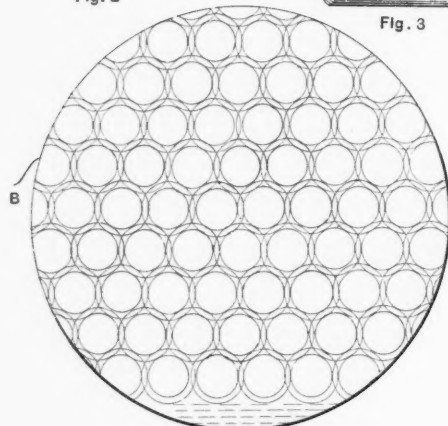


Fig. 4

Machinery, N.Y.

A Dowel-making Machine.

Fig. 4 is a diagram illustrating the arrangement of the dowels in the wooden bolt, or the cylinders in the wooden block. The logs are mounted on a saw carriage and sawed into sections of the length of the finished dowels. The dowels then cut by the tubular saw are a finished commercial product but, usually, are intended as blanks for the making of spools, clothes pins, handles, etc. As shown in the perspective view, Fig. 3, the edges of the throats of the saw teeth back of the cutting faces are beveled or flared outwardly. The purpose of this arrangement is to cause the sawdust to be thrown outward by centrifugal force when the saw is cutting instead of allowing them to remain in the throats and clog them.

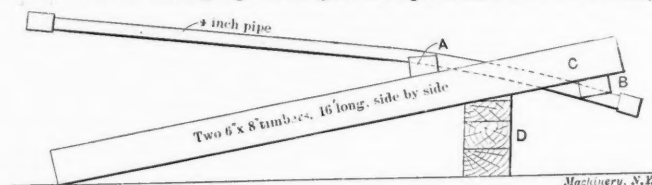
The forming cutter, Fig. 2, supplements the work of the tubular saw as may be seen in Fig. 1 at A. Here the cutter A is shown at work on the bolt of wood, B, cutting in advance of the tubular saw and removing the surplus stock for the periphery of the dowel. The section of the saw is seen surrounding the dowel. The cutter A routs out and forms nearly one-half of the dowel, thus providing ample room for the

escape of sawdust out of the throats of the teeth on the circular saw as well as greatly lessening the amount of work to be done by the saw in cutting out the remainder of the periphery and finishing the dowels, freeing them from the wood. In Fig. 1 the corresponding parts to be cut out by the saw in the succeeding dowels of the same tier are indicated by dotted lines. The dowels and the material cut out by the saw cuts are graphically illustrated for the entire bolt in Fig. 4, together with the small portion at the lower edge of the bolt which is required for gripping in the holder of the machine.

* * *

EMERGENCY RIG FOR BENDING PIPE.

While the streets of New York have a never-ending human interest it not often that the editorial eye sees therein anything of marked mechanical interest that might be classed as a "shop kink," but here is an exception. The job of bending heavy 4-inch pipe in a city street, giving each length two offset bends, is one that most of us would rather not tackle; it would be bad enough to do it in a shop equipped with some suitable appliance. The cut illustrates a street rig that works well, provided enough "dagos" are at hand to give the necessary *avoids* when the bending operation is done. It has the merit of taking up little ground space and can be readily



Pipe Bending in the Street.

extemporized from standard lumber sizes. Two 6 x 8-inch timbers about 16 feet long are laid side by side about 5 inches apart with one end elevated on blocking, D. The pipe is placed between the timbers and the cross pieces, A and B are placed as shown so as to form a fulcrum and a point of resistance for the short end of the pipe when the weight of the men is applied to the long end. It will be observed that the forces of action and reaction are balanced within the rig itself so there is no tendency for it to shift position. It is not exactly what might be called a labor-saver for six or seven men were employed on the job noticed, but for emergency work, where labor cost is a secondary consideration, it is certainly a meritorious scheme

* * *

It has not been an uncommon experience for an invention to be made and used without patent protection, and if it should occur that the invention comes into general use the natural inference is that the inventor has lost a large monetary return because of his neglect to protect his idea. While not denying that such may be the case, it is interesting to consider the other side of the question. For example, we might mention the ring-oiling device, first used, we believe, by Prof. John E. Sweet on the crankshaft of his famous "straight-line" engine. The device attracted little attention outside of the engine builders until the advent of the electric generator, when Edison recognized that the ring-oiler was an excellent device for lubricating the journals of this high-speed machine. His use of it was immediately copied by the builders of electrical machines generally, and now it is in common use throughout the world. But the fact that the invention was not patented undoubtedly to a large degree explains its immediate general adoption when it became known. A designer usually feels averse to using any device in a new machine for which royalty will have to be paid if another device, even if not so good but in common use, can be used instead. He is responsible to a large degree for the cost of the machine, and the specification of a patented part which may mean considerable dickering with outside parties before permission can be obtained for its use, is distasteful. If the patented device is something of a concrete nature which can be bought in manufactured form and applied with no further transaction the matter assumes a different form than when it must be manufactured as part of the machine and royalty paid thereon.

LETTERS UPON PRACTICAL SUBJECTS.

MOTOR EQUIPMENT.

I have read with much interest the article on the light machine shop in the June issue. The author gives a table of average horsepower required by various machine tools, which is only applicable to group driving and is by no means of general application. Every case has to be considered on its own merits, and in laying out the equipment of a machine shop it should be the object to have as many machines worked to their full capacity as possible. By this means their earning power is increased, as is also the actual power necessary for driving each tool; in other words aim to make the average power as near as possible to the maximum power required for each machine. This means the adoption of automatic machines wherever possible, and calls for much thought, but will produce results impossible by any other means. It is impossible to set any limit of power required for machines where it will pay to install individual electric drive; although at present it is generally considered more economical to operate machines requiring less than five horse power each by the group drive. Yet such ideas are liable to be changed if we look at a modern printing establishment, where it is universal practice to install individual drives on $\frac{1}{4}$ horse power presses, and it must be admitted that the equipment of the press room is more advanced than that of the average machine shop.

It should always be remembered that production is the principal consideration, and a greater production is possible where each machine is independently driven.

In the case of the 80 lathes requiring an average of 24 horse power, a good arrangement would have been to use three motors of 10 horse power each, as it is better to run short lengths of shafting, and in case of a break down less time would be lost.

Very important points to be considered are light and cleanliness in a shop, as they have considerable influence upon production. The fewer the belts the lighter and cleaner a shop will be.

Countershafts are quite unnecessary in a manufacturing machine shop, and for group driving an excellent method is used in Woolwich Arsenal, England, described by Colonel Holden in a paper before the Institution of Electrical Engineers, November, 1905. There is one main line shaft having a cone pulley over each machine. These cone pulleys are not carried on the main shaft, but on tubular bearings through which the main shaft passes clear, the bearings being supported on brackets (see illustration No. 6, opp. page 48, Journal of Inst. E. E., Vol. 36). The cone pulley carries the armature of an electromagnetic clutch and the electromagnet is keyed to the shaft. These clutches are quite reliable and very efficient as they do not require more than one-fourth of a watt per horsepower, or 1/3000 part of the power transmitted. Although individual electric drive is apparently too expensive for small machine tools at present, the time will come when the motor will be an integral part of every machine.

C. H. HADRELL.

Cincinnati, O.

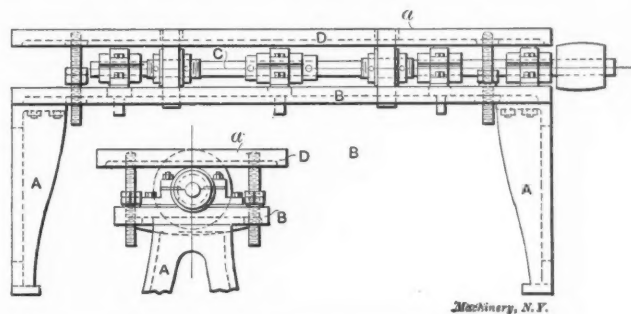
A SURFACE GRINDING MACHINE.

The accompanying sketches show a surface grinding machine, as used by a large eastern establishment for grinding surfaces that have to be scraped; it can be used for a great variety of work, with a considerable saving of files and time. It is very simple in construction, and not very expensive; one of those handy home-made tools the boys wouldn't do without after its usefulness has once been appreciated.

In almost any shop there is a lathe or other machine, whose time of service has ended, which is fit only for the scrap heap. Its legs can be used for the grinding machine as shown at A.A. On these legs is fastened a cast-iron plate B, to which are attached the shaft bearings C, provided with double grinding wheels to accommodate two men. A machine with one wheel can be constructed in the same way, where there isn't much grinding to be done. The two wheels are held in place by means of large nuts with right and left threads screwed

on the shaft. D is the upper plate, and has screwed to its under surface four long studs, each furnished with double nuts. These four studs fit in four holes drilled on plate B, as shown. Face *a* must be perfectly true. By means of the nuts, plate D can be set in such position that the two grinding wheels, which must be of the same diameter, will be tangent to the upper face *a* of the plate D.

When the upper plate is set properly, the four upper nuts are tightened, to keep it in the right position. Two collars, one on each side of the central bearing, keep the shaft in place. The wheels should run very true.



Front Elevation and End View of Double Surface Grinder.

Evidently any irregular surface that slides on face *a* will have its irregularities ground down. I have seen large piston rings and ring segments, badly sprung, that otherwise would have been filed or machined over again, ground easily and almost to perfection in a short time on one of these grinding machines.

J. M. MENEGUS.

Los Angeles, Cal.

[The means provided for adjustment of the table D are primitive, as might be expected in a "homemade" tool, but the very fact that the adjustment is not easy to change undoubtedly is one reason for its success. The ordinary commercial grinder of this type is not a great success because of the difficulty generally found in keeping the wheel in good condition, and this is largely the fault of the operator in "monkeying" with the table adjustment so as to make the wheel cut faster. Such machines should be set so that a very thin cut is taken, and then they work very well.—EDITOR.]

A MILLING ATTACHMENT FOR DIE SINKING.

I enclose herewith a sketch of an attachment for milling long semi-cylindrical grooves with a vertical milling machine or die-sinker. This device is used in the die-sinking shop of a large drop-forging plant making many automobile parts, such as axles, etc.

The shaft A is connected to the spindle of the milling machine or die-sinker, and carries a bevel pinion B. This pinion drives the spur gear D through the medium of the bevel gear C. The gear D meshes with the teeth of the milling cutter H, thus driving it. In order to make the device as compact as possible, the face of the bevel pinion B is recessed to clear the spur gear D. The milling cutter has no arbor, but is carried by two gimbals or centers, K, of which a separate sketch is given. These, when adjusted, can be held in place by the setscrews J.

The whole apparatus is mounted in an extremely heavy and stiff frame, F, braced by arms G to the milling frame. This bronze frame takes the thrust of the cutter, and steadies it. The shafts run in bronze boxes with ample provision for oiling. The spur gear is also of bronze, so that by no chance can the teeth of the cutter be injured by failing to mesh with those of the gear.

The length of groove which can be milled with this attachment is limited only by the longitudinal travel of the bed of the machine to which it is attached. The writer has seen grooves three feet in length which were the work of this appliance. Previous to the introduction of this device into the shop, it was customary to rough plane the grooves, and then

finish them by clipping and filing, a laborious and time-consuming operation requiring highly skilled labor, as accuracy was necessary. "DIDYMUS."

[It is not quite clear from the letter given above whether the cutter is fed through the work axially, or in the same way that it would be in an ordinary horizontal miller. Presumably,

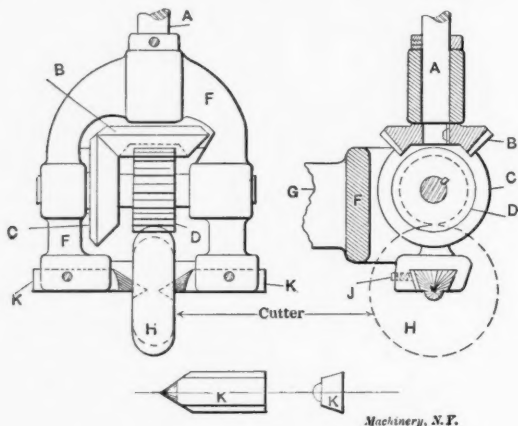


Fig. 1. Milling Attachment for Die Sinking.

however, the former method is used, since otherwise this attachment would offer no advantage over an ordinary milling machine. This device, rearranged to be driven by a horizontal spindle and thus requiring no bevel gears, has been used for many years in die-making for such work as that shown below in Fig. 2. It will be noticed that the design allows a cutter

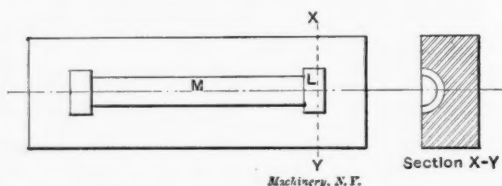


Fig. 2. Sample of Work which may be Done with the Device.

to be sunk in the metal clear to the center line. Semi-cylindrical pockets like those shown at L can then be easily machined in the die. The groove M may be afterwards either milled or planed, as desired. Other uses will readily suggest themselves.—EDITOR.]

AN ADJUSTABLE HOLLOW MILL.

An adjustable hollow mill is by no means a novelty for such tools were long ago put on the market by the Brown & Sharpe Mfg. Co. One difficulty with the Brown & Sharpe tool, however, is that the adjustment to an exact diameter is somewhat troublesome and requires considerable skill on the part of the workman. The hollow mill shown in the cut, Fig. 2, was made to simplify the matter of adjustment and its construction is plainly shown in the line cut, Fig. 3. The adjustment is effected by a threaded ring, A, which is bored out conical at the front end where it bears on the ends of the

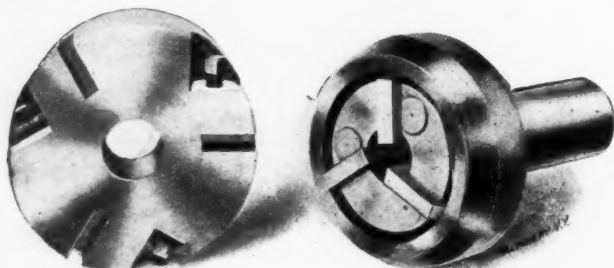


Fig. 1. Jig for Grinding Blades.

Fig. 2. Improved Adjustable Blade Hollow Mill.

cutting blades. The position of the three blades, C, is such that their cutting edges are radial and they are clamped with bolts, B, with nuts at the back in a similar manner to the regular Brown & Sharpe tool. The ring not only effects simultaneous adjustment of the blades but prevents them working out in case the clamping bolts loosen.

It is important when the blades are reground that they all be ground to the same length. For this purpose the jig shown in Figs. 1 and 4 was made. The blades are clamped in the three slots by the setscrews shown, being reversed so that the bevel ends rest on the cone piece A and this of course puts the cutting edge out; they are then sharpened exactly the same as a cutter with inserted teeth, the sharpening of the edges taking place on the cylindrical surface as well as

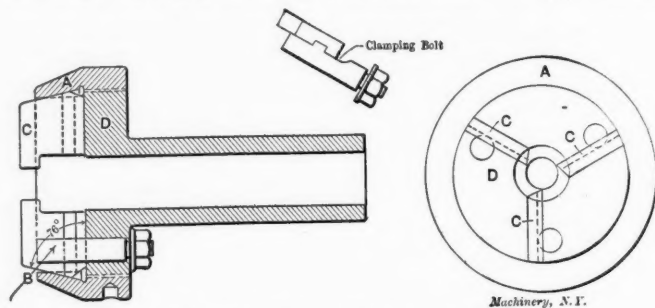


Fig. 3. Construction of Hollow Mill.

on the face. The grinding operation is effected by mounting the jig on a mandrel and treating it the same as an inserted tooth cutter, as already stated. It is quite evident that all the blades must be ground to the same length in this manner and when mounted in reversed position in the tool-holder they will all stand with the cutting edges the same distance from the center of the tool.

Berlin, Germany.

OTTO ECKELT.

BOILER HORSE POWER FOR STEAM HAMMERS.

In the March issue of MACHINERY there is a communication giving rules for finding the capacity of steam hammers, and the horse power required for operation. Outside of the question of the kind of steam hammer in use—whether one in which the steam merely lifts the tap, which latter operates on the work only by its own weight, less friction, or one in which there is a direct blow caused by live steam on the upper side of the piston—there is a much more important question, as to what the "horse power" of a boiler really is. The hammer certainly exerts a definite horse power; that is, there is a certain weight lifted a certain number of feet in a minute, or a certain number of pounds pressure exerted through a certain definite distance per minute; but the same boiler will do different amounts of work in the two different types of hammer, or to put it the other way, the two different types of hammer, rated at the same capacity in pounds, will get dif-

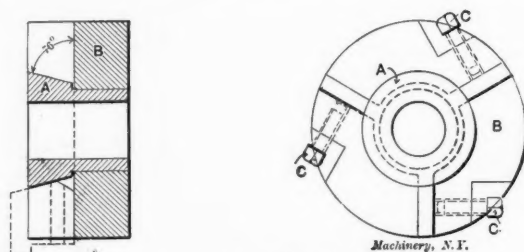


Fig. 4. Construction of Jig for Grinding.

ferent amounts of work out of the same boiler—that is, one type will work at its rated capacity with a boiler which can not supply the other.

And as to the "horse power" of a boiler, that is the worst kind of a misnomer—one engine will get three times the horse power out of a given boiler, that another will; and a duplex steam pump or a steam hammer will take many times more steam to exert a given horse power, than any engine in use to-day.

Another question comes in, as to what "constantly" means. One hammer is running "constantly" when it is making ten strokes a minute and another will take a hundred and fifty strokes to be entitled to be working "constantly"—this, independently of pauses. The same hammer, rated in pounds of blow, will have to work twice as fast on one kind of work, as on another.

The rule seems to me to be something like the way to get the weight of a pig by balancing him against a stone and guessing at the weight of the stone. ROBERT GRIMSHAW.
Hanover, Germany.

CHANGING DRAWINGS.

Probably one of the most important problems coming up to draftsmen in general, is making changes on drawings. The changes I particularly refer to are those required in shops manufacturing standards, when some fellow comes along and wants his order filled a little different. He just changes from the standard enough, probably, so that the original drawings cannot be used, and then it's up to the draftsman to make a new drawing or change the original. As the original is standard, it is not desirable to make erasures on it; therefore, the problem is at hand. To make a new drawing would require a lot of time, and as time is money with the boss, it is our duty to devise some means of saving it for him. A method for doing this which I have found that reduces expenses to a minimum may be briefly described as follows:

From the original drawing make a brown print, using a thin, tough paper. This gives a print with clear white lines on a brown background, the brown being impervious to light. Paint out on this print, with ordinary drawing ink, the lines not desired on the changed drawing, after which make a second brown print from the first. The print thus obtained has dark brown lines on a white background. Draw in on this print the changes and you have the new drawing desired, from which blue prints can be made.

The writer has used this method for some time and finds it a very desirable one. G. L. P.

TO DETERMINE THE ANGLE OF A DIE-BLOCK SLIDE TO MATCH THE KEY.

There appears to be a mistaken idea regarding the taper of die-blocks and their keys. It is quite common to see drawings with the same taper per foot indicated on each. This is not correct, and in cases where they are so marked it always requires an extra fitting of the key.

From the sketch it can be seen that when looking at the key in the position marked A the normal taper is apparent,

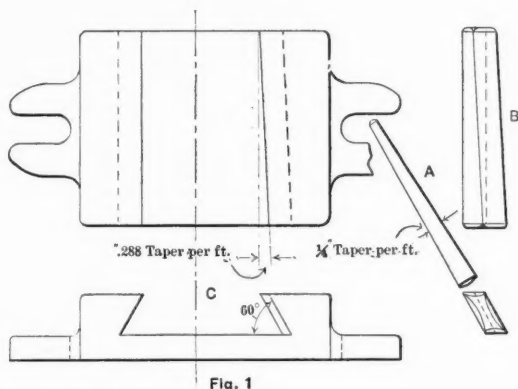


Fig. 1

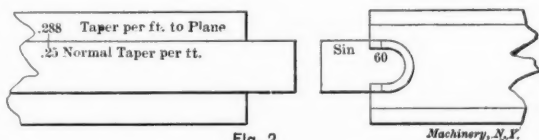


Fig. 2

Variation in Angle of Die Block Slide Due to Angle of Key.

but when viewed as in position marked B it assumes an oblique position which makes the angle in the die-block differ from that of the key.

The angle of the die-block can be found by dividing the normal taper per foot of the key by the sine of the angle of the slide. For instance, taper per foot of key is 0.25, the slide is 60 degrees and the sine 0.866; therefore $0.25 \div 0.866 = 0.288$ inch, which is the taper per foot of the die-block. To avoid questioning in the machine shop, it is well to state that

the 0.288 inch taper per foot is equal to the normal taper of $\frac{1}{4}$ inch per foot of the key.

Although alluding principally to die-blocks and their keys, it is of more importance that machine slides and their taper gibs should be dimensioned correctly, as they (especially long ones) are not so easily fitted.

The method of making this calculation on the slide rule is also shown. Set rule to the sine of the angle c and set the runner on the scale B over the normal taper per foot of the gib or key, and on scale A read the taper, to which plane the die-block. The difference in angles is more noticeable as angle c decreases; for instance, should it be 20 degrees and the taper of the gib remain 0.25 inch per foot, the angle for planing would be 0.731 inch per foot. WINAMAC.

PRACTICAL SYSTEMS.

Manufacturing establishments of the present day are run to make money and not for the purpose of affording lucrative positions wherein men can show to the world what brilliant talent they possess. It matters not how much of a genius a man may happen to be, or what his scientific attainments are, if they cannot be utilized for the practical results that are required and for the financial gain and benefit of the man or the concern which employs him. Results count, and if one man cannot produce them he is likely to be turned down in favor of a man who can.

The up-to-date manager, eager to make a good record and to have the business of the establishment of which he is the head, come out on the right side of the ledger at the close of the year should not be misled by the man with the brand new system, the like of which was never before seen or heard of; that will produce such astonishing results; that will fill the office with an expensive lot of filing cases, cards, blanks, charts, and other marvelous devices, and such an elaborate and intricate method of indexing, filing and handling the information derived from a mass of technical reports ornamented with symbols and strange hieroglyphics, and received every ten minutes from all parts of the plant, until it requires an extra dozen clerks to run the thing and gives him such a mass of figures and scientific deductions about a whole lot of things that he doesn't want to know and hasn't time to wade through if he did. But what he wants to know is: How much consumable supplies cost last month; why they cost 20 per cent more than the month before; what was the cost of the stock used on that job for Billings; why did Johnson's job get "hung up" for three weeks; how does it happen that there are five idle machines in Smith's department when an order from Jones has been in the office for a week that might just as well have been pushed along on those idle machines; why Robinson is getting just the same pay as Oliver and turning out only about half the work; why Porter's name did not get on the pay roll and no one in the office knew anything about him until he turned up on pay day.

When to get these and a thousand other practical items of information that are needed every day, but that the new-fangled and technically elaborate system does not give, he has to go out in the shop, just as he used to, and dig out the facts for himself, it is high time to get down out of the clouds, have a house-cleaning and get a system that will tell what he wants to know, and tell things pretty soon after they happen, and tell wrong things before they have an opportunity to happen at all; not minding about the more theoretical matters, however alluring it may seem from the scientific or technical aspects of the system, because if it does not produce practical results and give, not only a detailed but a comprehensive idea of what is going on in the establishment, from the office to the shipping room, it is not wanted and the practical business manager cannot afford to have his administration loaded up with it.

This is not a tirade against systems, as such, but is just a few remarks in reference to the impractical systems that one finds in some of the would-be-up-to-date establishments of today; against the conditions in this respect which may be well described as system gone to seed. A proper, practical system, devised to suit the local and individual conditions, which have been carefully studied, comprehensively considered, and the

requires an arc of 145 degrees. From the point of intersection of the vertical line with the heavy horizontal line on which are marked the speeds in feet per minute, run a diagonal line toward the lower left-hand corner, as shown by the dotted lines. At the point where this diagonal line intersects the proper horizontal for the required arc of contact, graduations for which will be found near the left edge of the diagram, erect a second vertical line to the scales at the top of the cut. Following the dotted lines and arrows shown, this gives us on the scale *B* about $3\frac{1}{3}$ horse power per inch. Multiplied by 6 inches, the width of our belt, we have a capacity of $6 \times 3\frac{1}{3}$ or 20 horse power. To still further illustrate the effect of a variation in the arc of contact consider the same problem with 220 degrees contact. Continue the diagonal line drawn for the last problem in the other direction, through the horizontal graduations corresponding to 220 degrees. From the point of intersection of the diagonal and the horizontal, erect a perpendicular to the scale above. This gives about $4\frac{1}{4}$ horse power per inch on scale *B* or about $25\frac{1}{2}$ horse power for a 6-inch belt. This operation is also shown by dotted lines in diagram. Toward the end of each of the four scales *A B C* and *D* will be found a figure marked "decrease." This signifies that after that point in the scale is passed further increase in belt speed per minute will result in a decreasing power transmitted, owing to the action of centrifugal force on the belt as it passes around the pulley. This has the effect of lessening the arc of contact, and the pressure between the belt and face of the pulley as well.—EDITOR.]

JIG KNOCK-OUT FOR TIGHT WORK.

I had the job of drilling some drop forgings, like that shown in Fig. 1, in a jig and had considerable trouble in getting them out of the jig owing to the chips, the forgings being a neat fit having been milled on all surfaces before drilling. There were three blind holes drilled in these forgings and the chips would rest on the bottom of the holes and stick up into the jig locking the jig and forging together so that it was necessary to drop the jig on the floor each time to jar the forging loose. I soon got tired of this performance and devised the fixture shown in Figs. 2 and 3 to loosen the forgings after drilling.

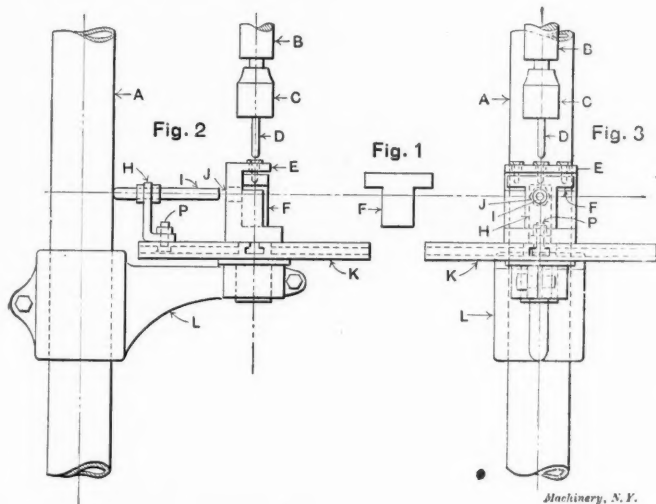


Fig. 1. Forging to be Drilled. Figs. 2 and 3. Front and Side of Drill Press with Knock-out Attached.

Figs. 2 and 3 show the front and the side of the drill press with the fixture for removing the work from the jig. *A* is the drill press column, *L* is the table bracket, and *K* is the table supporting the jig *E*, in which is the drop forging *F*. This forging was clamped in the jig by a clamp, not shown, which encompassed the front of the forging and the back of the jig. A hole, *J*, was drilled in the back of the jig and an angle-piece, *H*, was bolted to the table in which a rod, *I*, was secured by nuts. The hole, *J*, was drilled at such a height that its center was of the same height as the hole in *H* and was made considerably larger than the rod so that there was no trouble in entering it when loosening the forging. To re-

move the work after removing the clamp the operator takes hold of the jig on each side and shoves it back so that the rod *I* enters the hole in the back of the jig, striking the work and pushing it out. This is much better than dumping the jig on the floor and lifting it back again for each piece.

Philadelphia, Pa.

C. W. J.

EXPANDING LATHE MANDREL.

The expanding lathe mandrel shown in section in Fig. 1 is one that was made for turning the shells down in Fig. 3. These, as it will be seen by referring to the dimensions, are very light and thin, the finished thickness of the wall being only $\frac{3}{16}$ inch. The body of the mandrel is made of a casting, *A*, which is squared at one end, *G*, for the lathe driver and

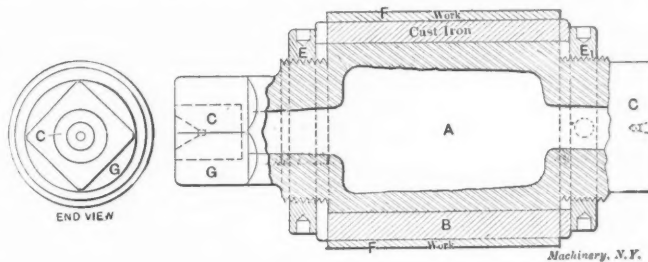


Fig. 1. Expanding Mandrel for Turning Shell.

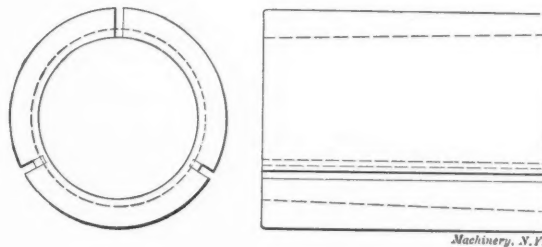


Fig. 2. Bushing Used with the Mandrel.

threaded at each end for the nuts *E* and *E*₁. The body of the mandrel is turned to a taper of about $\frac{3}{4}$ inch to the foot, and on this part is fitted the cast iron expanding bushing, *B*. This bushing, shown in Fig. 2, has three longitudinal cuts evenly spaced on the periphery, and one of the cuts goes through to the bore. The ends of the arbor, *A*, are bored out and hardened steel centers, *C*, are fitted therein in which are carefully reamed centers. A spanner is provided for tightening and loosening the nuts *E* and *E*₁, which is necessary, of course, when putting on and removing the work, *F*. The arbor is driven by the driver shown in Fig. 4. This screws on the lathe spindle and has a square hole cored in the end for the reception of the squared end on the arbor. This arrangement makes a very neat and compact drive and one which, if prop-

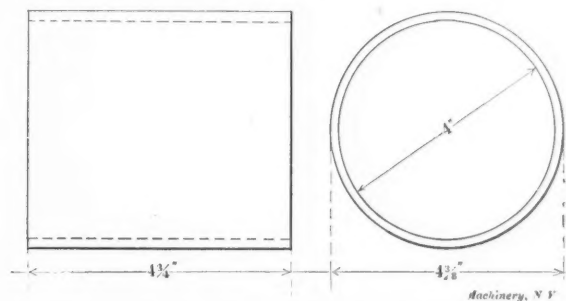


Fig. 3. The Bushing which is to be Turned.

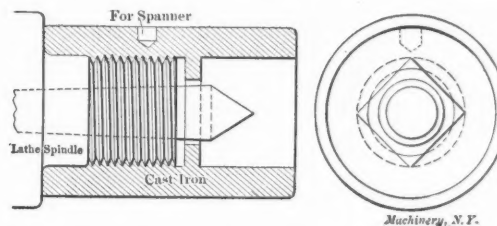


Fig. 4. Driver for the Taper Arbor.

erly made, drives the arbor from all four corners of the square and in this manner avoids the tendency to eccentricity which is always present when the work is driven by a single-tail dog.
W. T.

CARD INDEX FOR DRAFTING ROOM.

The card index system has proven a valuable aid in facilitating the drawingroom work, most particularly for keeping track of drawings of varying kinds and descriptions. However, it is apt to become rather voluminous if the business is a growing one, and even though one may add all the card-index guides possible, dividing the index into classes and subdivisions, there will invariably be some sub-divisions that will contain more cards than are convenient to look through every time a drawing is to be found.

For this reason I thought it appropriate to give a sample of a card that will make the index less voluminous, and at the same time permit a saving of time when looking up a drawing. It has been the usual practice to make one card for each drawing indexed. This is, however, not necessary as long as there will always be a certain number of drawings of the same kind of tools or articles that can conveniently be listed on the same card. The card depicted shows plainly the principle employed in regard to using the index guides, having first guides for general classes, and then for subdivisions. On the third

CLASSMilling Machine Fixtures.				
SUBDIVISION . . .Fixtures for parts of Multi-spindle Drills.				
FIXTURES FOR FEED RACKS.				
No. of Drawing.	Date Issued.	Draftsman..	Description.	Date Superseded
2716	6 13-1904	Smith	For 4-spindle drill, 1½ center-distance.	12-31-1905
3563	9-27-1905	Leland	For 3-spindle drill, 1½ center-distance.
4716	12-30-1905	Leland	For 4 spindle drill, 2½ center-distance.
4719	12 31-1905	Leland	For 4-spindle drill, 1½ center-distance.

Arrangement of Drawing Card to Save Space.

line of the card is given the general name of the class of articles for which the drawings on this card are made. The remainder of the card can be used for filling out from time to time additional drawings belonging to this same general description. It will be seen that by means of this system the card index can be easily reduced to a fraction of its original volume. As the draftsman is well aware, the average life of a drawing is rather short and still, as superseded drawings have often to be referred to, it is well to systematize the drawing room so that the superseded drawings are kept on file right with the regular ones, but marked "superseded," and with the date the reissue took place. In order to save unnecessary delay in looking up a drawing the date when the drawing was superseded should also be marked on the card in the index. With the exception of these remarks the picture of the card will explain itself, and I hope it may prove a time-saving suggestion to some drawing rooms that work under difficulties with rapidly expanding card-index systems.

Hartford, Conn.

ERIK OBERG.

STIFFENING A LONG BORING BAR.

When using a boring bar to take heavy cuts in deep holes, it is impossible to hold the tool with any degree of rigidity by the means ordinarily used. The boring bar is so long that it has tremendous leverage on the comparatively narrow boring surfaces of the compound rest and the main slide rest. The more joints there are in the tool post and slide the worse the conditions become. The accompanying sketch shows an arrangement which may be used to relieve the slide rest bearings of the greater part of the strain, holding a bar very rigidly and doing away with chatter, no matter how heavy a cut is being taken. The device was adopted primarily to avoid

the breaking of the dovetail on the tool slide and compound rest.

D is a boring bar held in a tool post E, whose construction is clearly shown in Fig. 2, although its exact design is immaterial to the success of the device described. F is a stiff

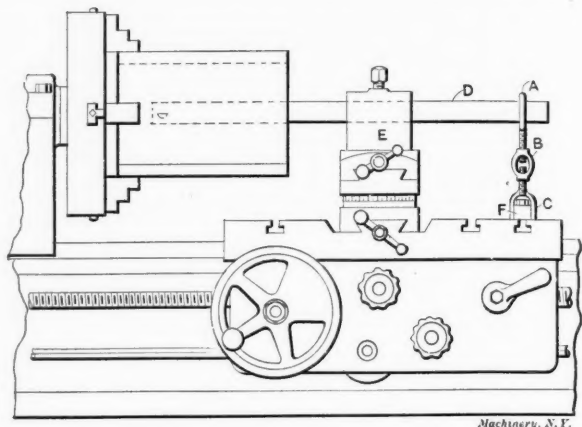


Fig. 1. Stiffening a Long Boring Bar.

steel bar provided with two bolts G by which it is fastened in the T-slots of the carriage, as shown in Fig. 1. A is an I-bolt, forged of 5/8 stock, which encircles the boring bar. A similar I-bolt C is adapted to encircle the bar F. These two bolts are connected by turn buckle B, and this is screwed up

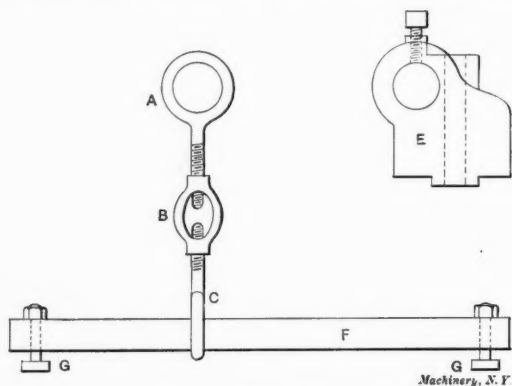


Fig. 2. Details of the Attachment.

until the parts are in tension, thus relieving the bearing surface of the slide rest of the bending strain due to the cut at the front end of the bar.
ALBERT ANDREWS.
Chicago, Ill.

* * *

FRENCH RULES FOR ABBREVIATIONS OF METRIC SIGNS.

The French minister of public instruction has decided that all teachers throughout France are in future to employ the following distinctive abbreviations for the various weights and measures For denoting length—myriameter, Mm.; kilometer, Km.; hectometer, Hm.; decameter, dam.; meter, m.; decimeter, dm.; centimeter, Cm., and millimeter, mm. For areas—hectare, ha.; are, a, and centiare, ca or m². For measures of bulk (timber, decastere, das; stere, s or m³, and decistere, ds. For measures of mass and weight—tonne, t; quintal metrique, q.; kilogramme, kg.; hectogramme, hg.; decagramme, dag.; gramme, g.; decigramme, dg.; centigramme, cg., and milligramme, mg. For measures of capacity—kiloliter, kl.; hectoliter, hl.; decaliter, dal.; liter, l.; deciliter, dl.; centiliter, cl., and milliliter, ml. The use of capital letters for the three largest denominations of length are intended to prevent confusion, and all the other abbreviations follow on uniform lines. The employment of full stops between the letters is officially abolished, and k. g. for kilogramme and m. m. for millimeter disappear.

* * *

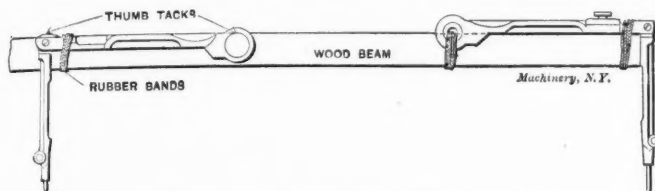
The city of Berlin has a very extensive system of pneumatic tubes for the handling of mail. The total length of the tubes in 1896 was 42 miles; in 1900 this had reached 47 miles, which was increased to 75¼ miles at the end of 1904. Sixty-nine stations are served by this system.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.
Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

A SHORT ORDER BEAM COMPASS.

A friend of mine, having need of a beam compass in a land where there was none, hit upon a scheme as illustrated by the sketch. He dismantled the compass belonging to his drawing set and fastened the needle-point end firmly to a stick about one-half inch square, and of the desired length. This fastening was accomplished by first notching one side of the stick to admit the hinge of the compass leg, so it might lie squarely

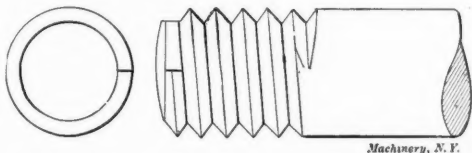


on top, and tying it with stout cord. The pencil leg was fastened by a thumb-tack through the eye, another on top to prevent "back-lash," and some rubber bands. This part, by the way, was placed at the side and not on top of the beam. The radius was easily adjusted by removing the two thumb-tacks and sliding the pencil leg to the right location. Once constructed, the compass worked as well as an expensive beam compass.

BESSEMER.

TO PREVENT "CROSS-THREADING."

I want to tell you of a way to prevent "cross threading." The first turn of a thread on a screw, and in a nut also, begins at nothing, at the bottom of the thread, and increases gradually, for one turn, to a complete thread. Take a file and chisel, and cut away this imperfect beginning of the thread up to where the full thread begins, both in the screw and nut. They will then always "start" right. It is the



gradual increase at the beginning that allows the thread to get wedged at an angle and the screw and nut to become what is known as "cross-threaded."

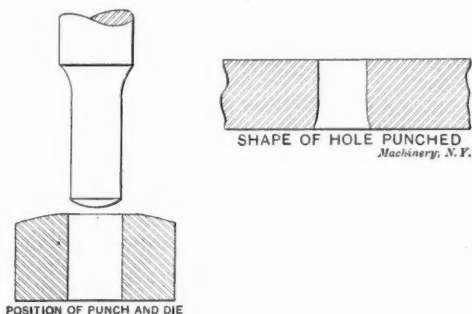
Try this on your lathe chucks, etc., where it is an advantage to have the threads start easily, and where "cross-threading" might injure a fine tool; also on pieces of large diameter, with fine threads, which are difficult to start properly, such as unions and other large pipe fittings.

Beverly, Mass.

C. E. BURNS.

PUNCHING HOLES THROUGH THICK METAL.

Some very interesting ways of doing work may be seen in agricultural implement factories; for instance, one piece made in such a plant is a piece of steel about 3 feet long, 2 inches



wide and $\frac{3}{8}$ inch thick at one end gradually increasing to $\frac{1}{4}$ inch thick at the other end. This piece is punched full of $\frac{7}{16}$ -inch holes. Most people will tell you that holes cannot

of the punch. The tools used on this job are shown in the accompanying cut.

The punch was ground rounding at the end instead of square across and it was not allowed to enter the die by about $\frac{1}{8}$ of an inch. For a $\frac{7}{16}$ -inch punch the hole of the die is made considerably larger, about $\frac{31}{64}$ in this case. This makes a hole somewhat bell-shaped, as shown in the cross section.

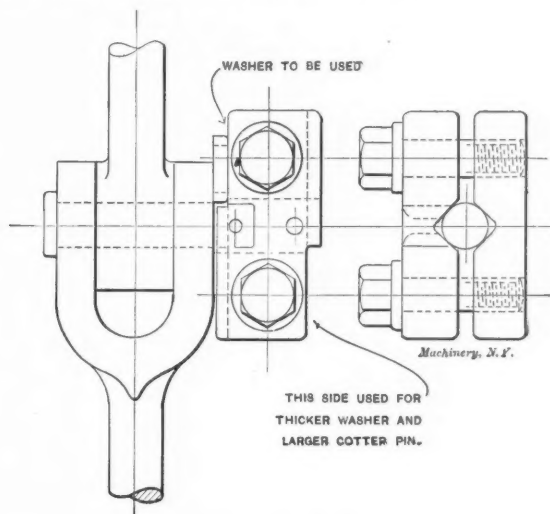
In one place where I worked the punches were forged, not turned. The operator of the press touches the punches up on the emery wheel after they are tempered and they are then ready for use. My experience has been that a forged punch, especially one made by drop or die forging process, is superior to one which has been turned to shape. The dies are machined in the usual way.

A. D. KNAUEL.

Moline, Ill.

JIG FOR DRILLING COTTER-PIN HOLES.

A jig for drilling cotter-pin holes is shown herewith which facilitates the operation as compared with the way it is commonly done. It consists of two pieces of steel forming a clamp, each piece having a V-groove to receive different diameters of studs. The upper one contains two holes which correspond with the size of cotter pins desired. Should more than the two sizes be required, extra top pieces can be used with



THIS SIDE USED FOR
THICKER WASHER AND
LARGER COTTER PIN.

the same bottom piece. Part of the upper piece is cut away on each side on a line with the edge of the holes, which allows the washer to be used to be inserted therein and the jig then clamped in position. By this means no scribing or spotting is necessary and a much better job can be done. Although it is shown it is obvious that the male portion of the joint need not be in position when drilling.

WINAMAC.

MAKING METAL FILLET.

I had occasion about a month ago to make several metal patterns and, not being able to procure metal fillet that would come up to my requirements, I decided to make it myself. I took some old three square files, ground off the teeth and then ground them to the shape of the fillet that I wanted. I took a piece of good high-grade tool steel and drilled holes just large enough to broach out to the form of the punch. The punch was made slightly tapered and I used one for about three holes, punching each hole a little deeper than the other. The draw plate was then hardened and tempered to a light straw. The fillet made in this way was quite small as I did not require a large size. To make a large fillet in this way would require the use of a draw bench strongly geared. For my use draw tongs and a bench vise did very nicely.

New York.

L. I. ROSENTHAL.

* * *

The report of tests made on the cork insert friction surfaces of the brake and clutches made by the National Brake & Clutch Co., Boston, Mass., mentioned in the business notes of the July issue, should also have stated that the average coefficient of iron surfaces is 0.16 and for bronze, 0.14, under the same conditions which gave 0.33 to 0.35 with the cork insert surfaces.

SHOP RECEIPTS AND FORMULAS.

A DEPARTMENT FOR USEFUL MIXTURES.

This page will be used for the publication of shop receipts which the contributors know from experience to be practicable. Nearly all readers of MACHINERY can add something, and it is desired that they use this page as a medium for exchanging useful formulas. It makes no difference if they are old and supposedly well-known, provided they have not already appeared in this department.

228. IMPERMEABLE CEMENT FOR PIPES.

To make an impermeable cement for steam, air and gas pipes mix thoroughly powdered graphite, 6 parts; slaked lime, 3 parts, sulphur, 8 parts, and boiled oil, 7 parts. The mixture must be thoroughly incorporated by protracted kneading until it is perfectly smooth and free from lumps.

Dayton, Ohio.

O. E. VORIS.

229. OIL FOR USE IN MICROMETER SCREWS.

To prepare oil for micrometers, fine mechanism, etc., take neatsfoot oil and put into it some lead shavings in order to neutralize the acid contained in the oil; let this stand for a considerable time, the longer the better. Oil thus prepared never corrodes or thickens.

JOSEPH M. STABEL.

Rochester, N. Y.

230. SOLDER FOR GOLD.

To make a solder for gold melt together in a charcoal fire 24 grains gold, 9 grains pure silver, 6 grains copper, 3 grains good brass; this makes a solder for gold ranging from 12 to 16 carats fine. For finer gold increase the proportions of gold in the composition. To make it darker in color lessen the proportion of silver and increase that of copper.

Rochester, N. Y.

JOSEPH M. STABEL.

231. TO ANNEAL FINISHED COPPER.

To make a mixture for protecting finished copper pieces which require annealing mix to a thick consistency white cold water paint and alcohol and apply to the copper with a brush. Allow the mixture to dry and then heat to a low red by dipping into pure melted lead at the required temperature. Cool in air or water, preferably the latter.

L. C. CARR.

Lynn, Mass.

232. FOR GLUING EMERY TO WOOD OR METAL.

The following is a good receipt for gluing emery to wood or metal and I have used it with success where other cements have failed. Melt together equal parts of shellac, white rosin and carbolic acid (in crystals) adding the carbolic acid after the shellac and rosin have been melted. This makes a cement having great holding power.

W. T.

233. BELT DRESSING.

I have found the following mixture to answer the purpose of a good belt dressing as well as an excellent anti-slip medium for hard-worked leather driving belts: Russian tallow, 1 ounce; best lard oil, 2 ounces; Venice turpentine, 16 ounces. This dressing is good to use on the belts of belt-driven motor cycles.

W. R. BOWERS.

Birmingham, Eng.

234. LUBRICANTS FOR USE IN CUTTING BOLTS AND TAPPING NUTS.

Mineral oils should never be used in thread cutting and tapping, as they do not generally flow freely enough. An excellent solution for this purpose can be prepared by dissolving 1½ pound of sal-soda in 3 gallons of warm water, then adding 1 gallon of pure lard oil. This is known as a soda solution. Pure lard oil is the best for fine, true work.

Urbana, Ill.

T. E. O'DONNELL.

235. VARNISHING BLUEPRINTS OR DRAWINGS.

The appearance of varnished blueprints and drawings may be greatly improved and the amount of bleached shellac varnish considerably decreased by the following process: Soak over night a quantity of isinglass in just enough cold water to cover it. Use a perfectly clean glue kettle, in which it is to be heated up, adding whatever amount of water may be needed to make a moderately thin sizing. Apply this warm, not hot,

to the drawing or blue print. When dry apply one good coat of bleached shellac varnish. The effect will be nearly as good as the best varnished maps.

OSCAR E. PERRIGO.

Neponset, Mass.

236. MOLDING MIXTURE FOR RUBBER STAMPS AND PATTERNS.

The following mixture is one which can be used for making molds for rubber stamps, or special shapes of rubber, or for complicated, odd, or queer shaped patterns, of small size, as the working must be done inside of ten minutes, and the surface takes a finish as smooth as glass if well rubbed. If an impression is to be made, the surface of the type or article to be impressed should be rubbed with a solution of kerosene, and graphite. Plaster paris, 5 pounds; French chalk, 2 pounds; china clay, 2 pounds; dextrine, ½ pound. Mix with dextrine water, which is made by dissolving 1 pound of dextrine in one gallon of water.

FRANK G. STERLING.

Lowell, Mass.

237. WASHING OILY WASTE.

The following is an excellent method of washing oily waste. The chief objection to most of the common methods employed is that the waste, after being dried, is found to be matted and of a hard, gritty texture. The common method of washing the waste, using sal-soda in solution, is a good one, as far as the cleaning qualities are concerned, but it leaves the waste hard and matted, so that it is difficult to handle. A simple remedy for this is to rinse the waste (after being cleaned in the sal-soda solution), in very hot water, to which has been added a quantity of liquid ammonia. This will render the waste soft and light when dry.

Urbana, Ill.

T. E. O'DONNELL.

238. A NICKEL BUFF.

For buffing nickel work, there is nothing that will give a luster equal to Vienna lime composition. It can be made by the user, but it is more satisfactory to buy it of the manufacturer, as when homemade it air-slacks very rapidly; it is put up by the makers in air-tight cans of about one pound each, and this shape will keep until used up. It is also a good buffing composition on brass or other metals where there is not much cutting down to do, as it will cut down and color in one operation. If there is much cutting down, go over the work first with tripoli, then color with rouge or lime. All these compositions are put up in different grades for fast cutting, and also for dry or greasy work.

J. L. LUCAS.

Bridgeport, Conn.

239. TO WRITE ON STEEL.

Stamping tools with steel stamps will spring them and throw them out of true. Machinists should write their names on their steel tools using a fluid made of nitric acid 1 part, water 2 parts. Heat the tool gently until some wax that has been put on it melts and spreads thinly over the surface. When cold blacken the wax at a candle; then write on the wax with a steel point deep enough to touch the metal, and cover the writing with the fluid. In about three minutes wash and remove the wax. This fluid, however, will spread more or less and the writing will not be very fine. A better fluid can be made thus: Alcohol 2 parts, nitric acid 1 part, distilled water 15 parts, and nitrate of silver ½ drachm per quart of fluid. Nitric acid, however, produces vapors that are disagreeable and harmful. Chromic acid made by dissolving one part of bichromate of potash in 5 parts of sulphuric acid, for this reason is more desirable as an etching fluid, although much slower in its action.

J. M. MENEGUS.

Los Angeles, Cal.

The unsettled condition of street numbers in San Francisco may be inferred from the following abstract from a letter sent to the Crocker-Wheeler Co. by their San Francisco office: "While it is not absolutely sure whether or not the number will be changed in from six months to a year, we think that our office may be considered as located at 206 First St. We have checked this matter of numbers over as carefully as possible, and we think that the above is as near as we can possibly get until the city authorities get to work and straighten matters out."

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

22. L. G. V.—Will you please tell me how to make a continuous ringing Faraday type bell; a single-stroke bell? Also please tell me how I can make a direct-current bell work on an alternating current?

Answered by Wm. Baxter, Jr.

Continuous ringing single-stroke bells are generally made by providing a clockwork to ring the bell, and a magnet to throw a catch in or out that stops the clockwork when the bell is not in use. The clockwork is wound up with a key, and will cause the bell to strike several hundred times before it runs down. A single strike bell of the type used for signalling is shown in Fig. 2. This kind of bell will strike once each time the switch is closed. It consists of a horseshoe electromagnet, A, which attracts the armature B. This armature is held on an arm that is attached to shaft C. Another arm on this shaft carries the bell hammer D. The spring E holds the striker in the position shown, and when the switch is closed, so as to send current through the coils on A the armature B is attracted and D swings down and strikes the gong. If D were allowed to swing freely all the way down to the gong, it would rest upon the latter as long as the switch is closed, and this would muffle the sound, hence the arm that carries D is made with some spring, and a stop is provided that will hold D just clear of the gong; then when D is thrown down by the pull of the magnet it will strike the gong and immediately spring back. In some cases the arm that carries

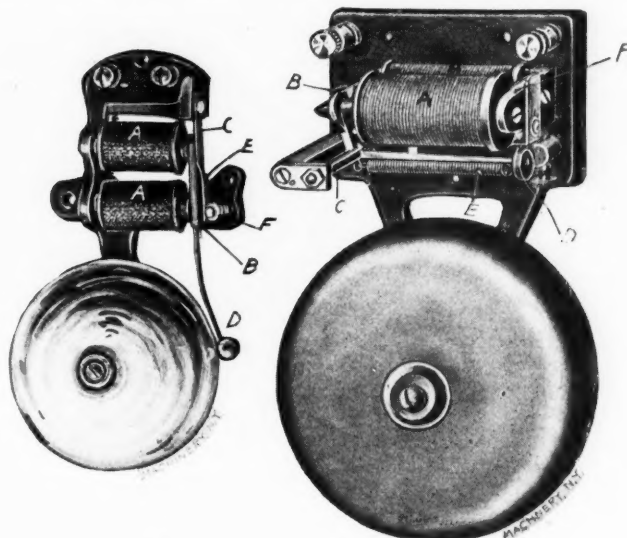


Fig. 1.

Fig. 2.

D is stiff, and the stop is made to spring. A vibrating bell is shown in Fig. 1. In this the magnet A attracts the armature B, which is supported by spring C, and D strikes the gong. The current passes through the spring E on the back of B to the stop F and these points separate when B is attracted, thus breaking the circuit and permitting D to swing back. The return movement of B brings E and F in contact again so as to close the circuit and send B forward once more. This action continues as long as the switch is closed. The rapidity with which D strikes depends upon the length from C to D. The best way to obtain the proportions of these bells is by examining one of the size you desire. They can be found in any railroad station in many designs and sizes. You cannot make a direct-current bell operate with an alternating current.

Another Answer to Question 20.

I notice in answering question 20 in the How and Why column of the July issue of MACHINERY, that you say you know of no method by which the radius of a circular arc can be calculated when only the length of the arc and the height of its middle ordinate are known. Though it is true that there is no formula which allows of a direct solution of this prob-

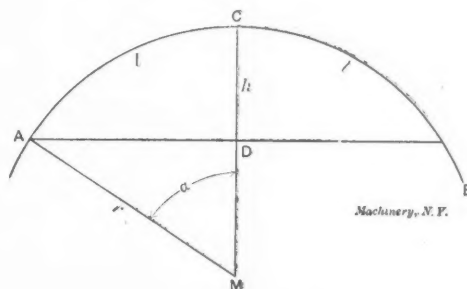
lem, yet it is easily possible to develop formulas which will lead to the desired result, and which can be solved by a method of repeated trials with little trouble and to any desired degree of accuracy.

AC is half the given arc and its length is called l , so that the length of the entire arc is $2l$. The height of the middle ordinate, CD, is called h . We know that $CD = AM \times \text{versin } \alpha$, and that the length of the arc $AC = 2\pi r \frac{\alpha}{360}$. We

thus have:
and

$$h = r \times \text{versin } \alpha \quad (1)$$

$$l = \frac{2\pi r \times \alpha}{360} \quad (2)$$



In these equations r and α are both unknown. From equation (2) we find by transposing that:

$$r = \frac{360 l}{2\pi \alpha} \quad (3)$$

Substituting this value in (1),

$$h = \frac{360 l}{2\pi \alpha} \times \text{versin } \alpha$$

If we call the value of the fraction $\frac{360 l}{2\pi} = c$, the equation becomes

$$h = \frac{c}{\alpha} \times \text{versin } \alpha \text{ or } h \times \alpha = c \times \text{versin } \alpha \quad (4)$$

This equation offers a solution for α by the method of repeated trial. It may be best to show by an example how this may be done.

Suppose the length of the arc is 30 inches and the middle ordinate is 4 inches; then $l = \frac{30}{2} = 15$ inches and $h = 4$. From this we find

$$c = \frac{360 \times 15}{2 \times 3.1416} = 859.41.$$

Substituting known values in equation (4), we have $4 \times \alpha = 859.41 \times \text{versin } \alpha$, or, simplifying:

$$\alpha = 214.85 \times \text{versin } \alpha \quad (5)$$

Transposing, we find that $\frac{\alpha}{\text{versin } \alpha} = 214.85$. For first trial we take any number of degrees, say 30 degrees. The versed sine of 30 degrees = .13397, or about $\frac{1}{7\frac{1}{2}}$, so that $\frac{\alpha}{\text{versin } \alpha}$ is about $30 \times 7\frac{1}{2} = 225$. This is near enough to 214.85 to try this a little closer.

For this trial we use equation (5). We find that $214.85 \times \text{versin } 30^\circ = 28.78$, which is not quite 30. As the versed sine increases with the angle, we now try a larger angle, say 31 degrees. We find $214.85 \times \text{versin } 31^\circ = 30.68$, so that even this angle is not large enough. We try now 31 degrees 30 minutes. $214.85 \times \text{versin } 31\frac{1}{2}^\circ = 31.66$. This quantity is now larger than the angle, so trying again for 31 degrees 15 minutes. $214.85 \times \text{versin } 31\frac{1}{4}^\circ = 31.11$. So that 31 degrees 15 minutes is the nearest angle in quarter degrees. Of course, it would have been possible to determine the angle with a greater degree of accuracy, even to seconds by a few more trials; but this is close enough for an example. From equation (3) we find now $r = 27.501$.

A. L. DE LEEUW.

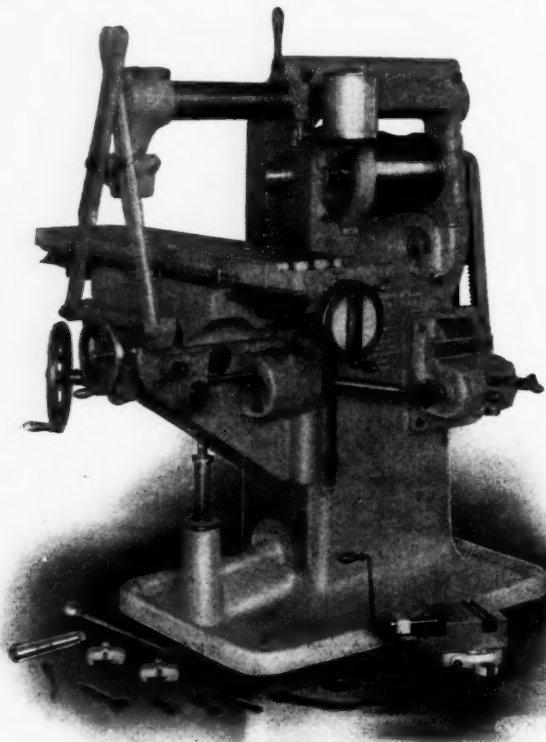
Hamilton, O.

MACHINERY AND TOOLS.

A MONTHLY RECORD OF NEW APPLIANCES FOR THE SHOP.

ADDITIONS TO THE BROWN & SHARPE LINE OF MILLERS.

The Brown & Sharpe Mfg. Co., Providence, R. I., have recently added to their line of milling machines a plain screw feed machine which they call their "No. 2 Heavy." This machine has the same capacity as the regular No. 2: 28-inch longitudinal feed, 8-inch cross feed, 19-inch vertical movement



Brown & Sharpe No. 2 Heavy Plain Milling Machine.

of the knee. A number of changes, however, have been introduced. The knee slide on the front of the column has been extended to the top of the casting, as will be seen in the accompanying halftone. This furnishes a stiff support for the front spindle bearing and permits attachments to be rigidly clamped to the face of the column. The hand wheels for the vertical and cross movements are provided with

these changes, the machine has been made about 35 per cent heavier than the regular No. 2 machine. This weight has been so apportioned as to give the maximum amount of stiffness for the heavy service which it is intended the machine shall give.

A four-step cone is used and back gears are provided, these being inclosed in the frame under the cone. The overhanging arm is a solid steel bar, round and true, and it can be pushed back over the table when not in use. It is simply and efficiently clamped at both bearings with one lever at the front of the machine, enabling the operator to make adjustments quickly. The table has an unusual vertical depth, which provides it with a sufficient stiffness against bending strains. It has a quick return operated from the right hand end of the table by an internal gear and pinion; the table feed screw is not splined, an auxiliary shaft being provided for driving the clutch gears. The thread being unbroken, the life of the screw end is greatly prolonged and the original accuracy maintained.

With the double speed countershaft furnished there are sixteen changes of speed in geometrical progression from 13 to 439 revolutions per minute; with eight reverse speeds from 22 to 305 revolutions per minute. The speeds have twenty changes varying from 0.004 inch to 0.2 inch in one revolution of the spindle. There are no loose change gears. The machine is regularly equipped with longitudinal cross and vertical power feeds, but can be provided with hand, cross and vertical feeds when desired. The approximate net weight of the machine is 3,600 pounds. A countershaft, together with vise, wrenches, etc., as shown in the halftone, are furnished with the machine.

A similar machine of a smaller size, the No. 1½, has also been designed. This is a screw feed machine with 24-inch longitudinal feed, 7-inch cross feed, 19-inch vertical feed. This machine likewise is provided with the new features of extended knee slide, clutched hand wheels, and releasing lever for disconnecting the feed chain sprocket from the spindle while the machine is in operation. The net weight of this machine is about 2,600 pounds.

THOMPSON UNIVERSAL GRINDER.

The Thompson Grinder Co. Springfield, Ohio have recently redesigned their universal grinder. The rearrangement of this machine has been effected without altering the principle upon

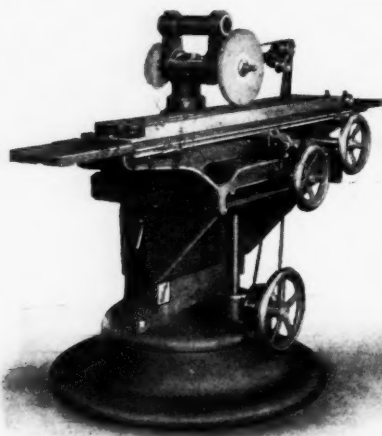


Fig. 1. Thompson Grinder Arranged for Surface Grinding.

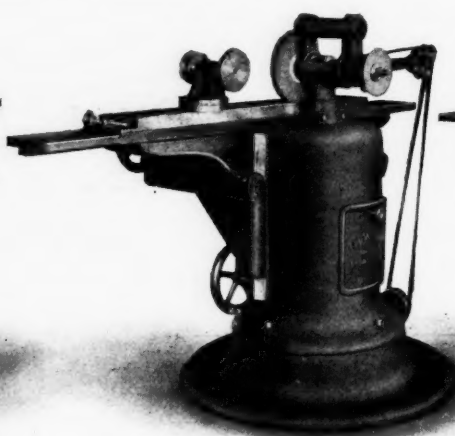


Fig. 2. Table Reversed and Head in Place for Face Grinding.

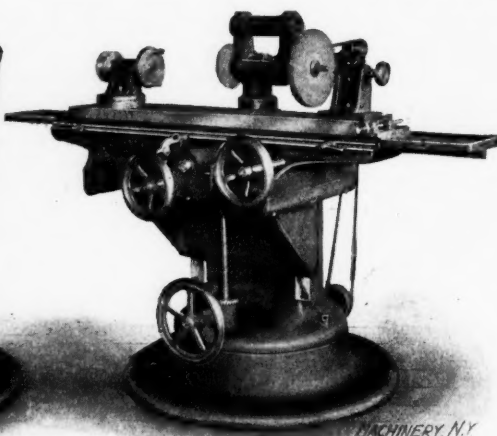


Fig. 3. Machine set up for Grinding between Centers.

clutches which can be disconnected after adjustments are made, thus doing away with the danger of accidental disarrangement of the setting, from pressing upon or hitting the handles of the wheels. The feed drive, which is of the geared variety driven by a chain from the spindle, can be disconnected from the spindle while the machine is running. Besides

which the machine was originally planned. Inasmuch as the grinding spindle is mounted upon a column that is solid with the base the grinding wheels remain in a fixed position. They do not tilt, or slide up and down, or in and out. A heavy outer casing surrounds the column and carries the grinding table and movable parts. This casing turns upon the base

and neck of the column through an angle of slightly more than 180 deg. and can be clamped rigidly to the base below and the neck of the column above at any position, thus bringing the grinding table to any desired relative position to the wheel at either end of spindle. The photos herewith, were all taken without moving the camera, the different positions shown being entirely due to the turning of the casing and table about the column.

A great advantage is claimed for this principle from the fact that the work is always brought to the wheel, instead of the wheel being made adjustable in relation to the work; thus but few attachments are needed to effect the various grinding operations.

It is claimed by the makers that this machine has a larger capacity, and will do a greater range of work than any other universal grinder yet produced. The main dimensions of work that may be handled on this machine are as follows: Knife grinding to the full length of table, 48 inches; surface grinding, 7 inches by 36 inches, is easily accomplished (see Fig. 1); cylindrical and taper grinding, 10 inches diameter by 36 inches long, on small head and tail stock (see Fig. 3); internal grinding by use of a high speed spindle, the fixture of which is clamped in the head of machine (but not shown in the cut), extends from the smallest diameter desired up to the swing of head stock, which is 10 inches; large shallow internal grinding up to 30 inches diameter by 3 inches deep, may be done by using a special headstock and allowing the work to hang over the edge of table (see Fig. 2). This last feature adapts this grinder to the use of die making and maintenance.

Strong claims are made for this machine upon the point of large capacity for every form of grinding operation. At the same time, all kinds of cutter grinding can be done quickly and conveniently as on any small machine designed especially for cutter grinding. This latest pattern is the result of constant use and severe tests for several years past.

GARVIN DUPLEX MILLING MACHINE.

The Garvin Machine Co., Spring and Varick Streets, New York, have recently built a duplex milling machine, which presents a number of noteworthy features. The most noticeable departure from the usual practice, as will be seen from the cuts shown herewith, is the method adopted for driving

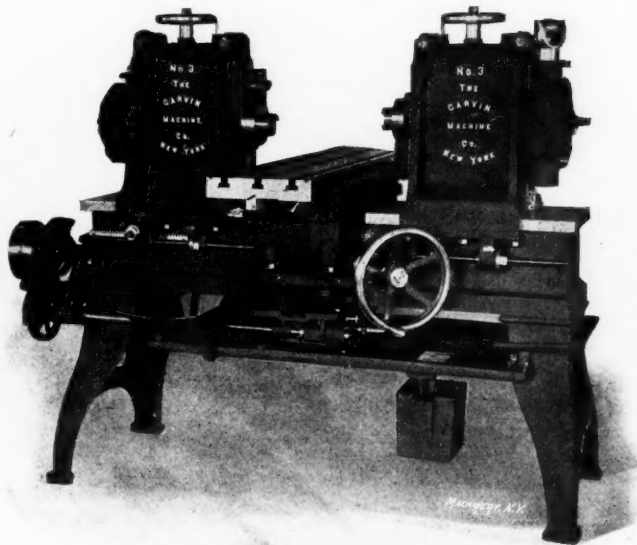


Fig. 1. Garvin Duplex Milling Machine.

the spindles, which receive their motion, not through belts as is the usual practice, but from vertical shafts with universal joints, leading from the overhead works. Another innovation is the provision of center supports for arbors for each of the two spindles, used when they are adjusted at different heights.

The line cut, Fig. 2, indicates the arrangement of the driving mechanism. The countershaft is driven by a friction clutch working within the cone pulley, which is in turn loose

on the countershaft and directly belted to a corresponding cone on the main line. Two sets of spiral gears, one in each hanger, drive a pair of vertical telescopic shafts, which are below connected to steep pitch worms, running in oil, and meshing with worm wheels on the spindles. This arrangement gives a strong, positive drive, allows perfect freedom for adjustment, and avoids all belts, idlers, and tighteners.

The spindles have taper bearings and run in bronze boxes. They are carried in strongly constructed slides which have a

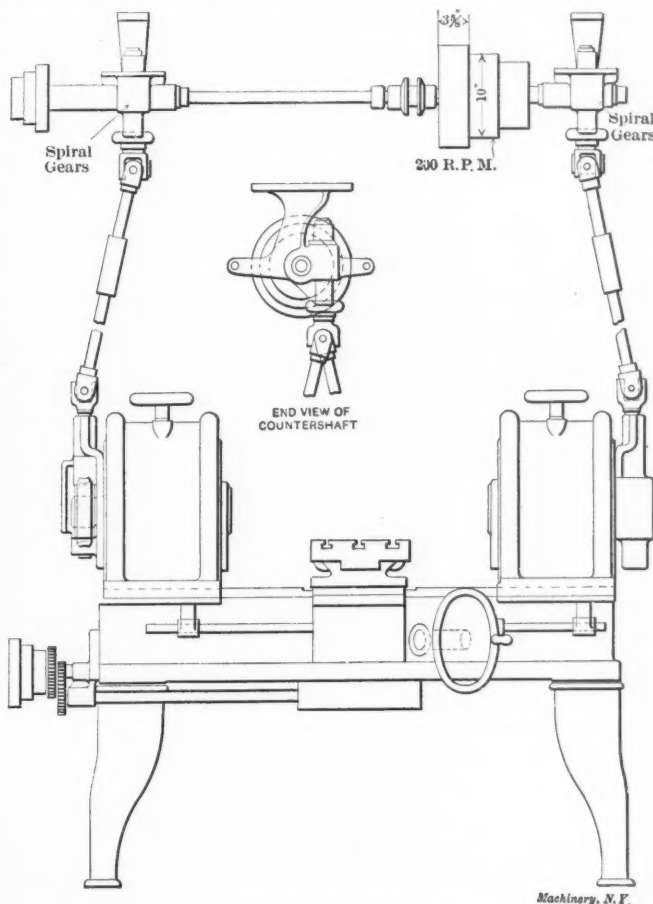


Fig. 2. Diagram showing Driving Mechanism.

vertical micrometer adjustment in the heads which carry them. Both of these heads have a micrometer adjustment along the bed, and one of them has, besides, a quick movement for running back to insert new cutters and arbors. Above the nose of the left-hand spindle, and below that of the right-hand one, will be seen in the halftone centers for the support of the outer ends of the two cutter arbors. These are adjustable within certain limits to permit a variation in the center distance between the two spindles. This arrangement permits the taking of cuts simultaneously on the top and bottom of a piece of work in cases where this is possible. Heavy cuts in steel can be taken in this way, feeding the work in between the upper and lower cutters.

The feed for the table is taken from a cone on the countershaft. The cone and the change gears furnished give twelve changes of feed. An automatic trip and reverse is provided, as well as a quick movement operated through a rack and pinion by the large hand wheel on the side. The length of feed is 42 inches; maximum distance between spindles is 5 inches; and the net weight of the machine about 3,120 pounds.

NEW HAVEN HORIZONTAL BORING MACHINE.

The New Haven Mfg. Co., of New Haven, Conn., build the horizontal boring machine shown in Figs. 1 and 2. On the bed is mounted a carriage with feeding and controlling mechanism similar to that of the lathe. At either side of the machine are mounted standards carrying the spindle heads, whose height can be adjusted to suit the position of the hole which is being bored. Between the centers of these two heads the boring bar is mounted.

This machine has a "swing" of 84 inches over the table. It takes 9 feet between the centers, although a bed 20 feet longer

can be furnished if desired, and it has a clamping surface on the table 48 inches long by 64 inches wide. The hand cross feed of the table is 52 inches. The head spindle, which has a diameter of $5\frac{1}{2}$ inches, is driven by planed bevel gears. The centers for both head and tail spindles have No. 6 Morse taper. Both heads have a vertical adjustment by hand, but they can also be raised and lowered by power. A special feature of the tail spindle, shown quite clearly in Fig. 2, is that by loosening the lower bolts the spindle can be swung up out of line with the boring bar, thus allowing the bar to be removed without loosening the adjustment of the center or changing the position of the table. This is done by the hinge construction as shown. Both heads are counterbalanced. The screw cutting range is from 1 to 12 threads per inch, with feeds from $1/100$ to $1/8$ inch per revolution. With a 16-foot bed the weight of the machine is about 30,000 pounds.

THE LATSHAW PRESSED STEEL PULLEY.

Two examples from a new line of pressed steel pulleys are shown in Figs. 1 and 2. The first halftone shows a six-arm pulley with reducing bushings removed from the hub;

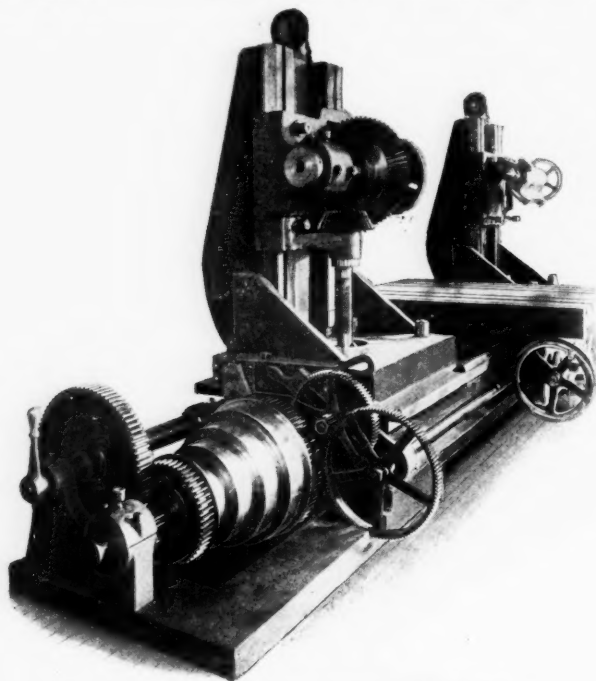


Fig. 2. Driving Mechanism of New Haven Boring Mill.

the second cut shows the double six-arm type used on the wider sizes. Larger diameters are provided with eight arms instead of six.

The pulley is of unusually simple construction. The rim

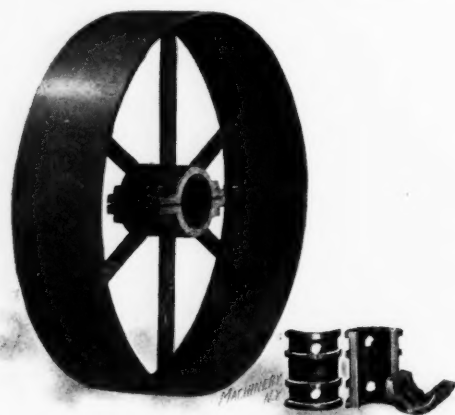


Fig. 1. Six-arm Single Latshaw Steel Pulley.

is formed of two curved sheets, bent for a straight or wound face, as may be required, clamped together by riveted and bolted ears on the inner surface, and punched with suitable holes for the arms. The hubs are drop forgings, made by an

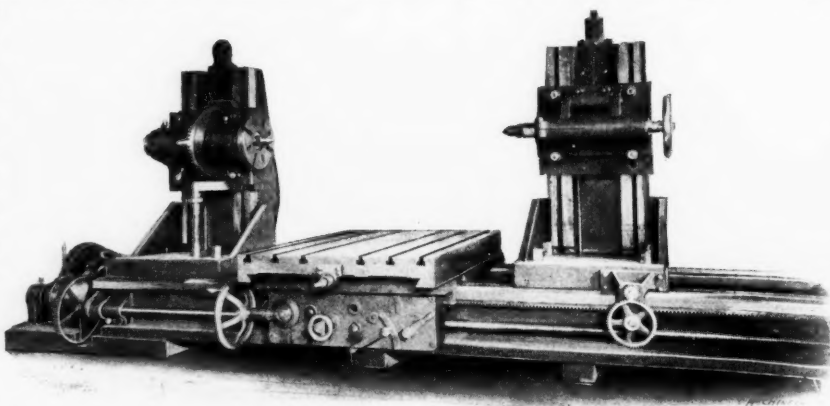


Fig. 1. New Haven 84-inch Boring Mill.

improved process developed by the builders, which brings them so closely to size and finishes them so smoothly that no machining whatever is needed on them. These hubs are also punched for the arms, which are solid steel rods, reduced to a shoulder at the ends where they enter the rim and the hub. After being assembled with these parts, the ends of the spokes or arms are upset, and the pulley is completed.

It is claimed for this pulley by its makers, the Latshaw

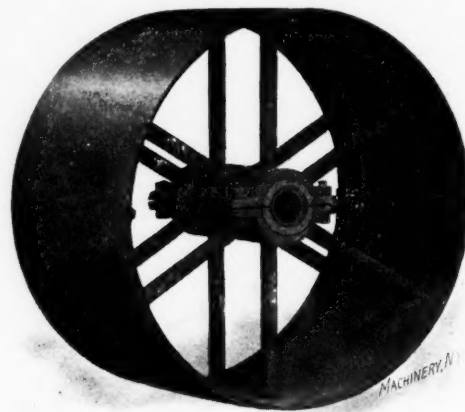


Fig. 2. Six-arm Double Pulley, with Bushings in Place.

Pressed Steel and Pulley Co., Pittsburg, Pa., that this design is the simplest and strongest of any yet manufactured. The parts are few and simple, the hub is sufficiently strong to resist severe clamping strains, and has a thick enough section to be tapped for setscrews. It is furnished in all standard sizes from 12 inches to 50 inches diameter, and in all widths from 3 inches to 24 inches, rounded or straight. All pulleys over 14 inches wide have double arms, thus strengthening the rim against collapse from excessive belt pressure.

THE WIDE RANGE DRILL CHUCK.

The Wide Range Drill Chuck and Tool Co., Muncie, Ind., have brought out a drill chuck which presents a number of novel features. The design of the tool will be readily understood from the accompanying cut. Fig. 1 shows a front view of the chuck, Fig. 2 a side view, Fig. 3 is a detail of the jaw guide, Fig. 4 is a longitudinal section, and Fig. 5 is a detail of the jaws. The same reference letters are used throughout.

To the shank A, which is fitted to the machine spindle in the usual way, is attached the base of the chuck B. Two flister head screws unite this part solidly with the jaw guide C, which is shown in Figs. 3 and 4 in two positions, being rotated in one case 90 degrees about the center line from the position shown in the other view. This part is milled out to form seats for two jaws, D and D₁, which work at right angles to each other, the one in the front face and the other

in the rear face of jaw guide *C*. Setscrews, *E*, in the jaws are tightened by a square end key, onto the tool being held, which is thus clamped in the V-shaped side of the openings in the jaws. Springs *F* keep the setscrews pressed against the outer shell *G*.

The action of the device is as follows: The parts being in the position shown in the cut, screw *E* is tightened down upon the tool, which is thus centered horizontally in the V

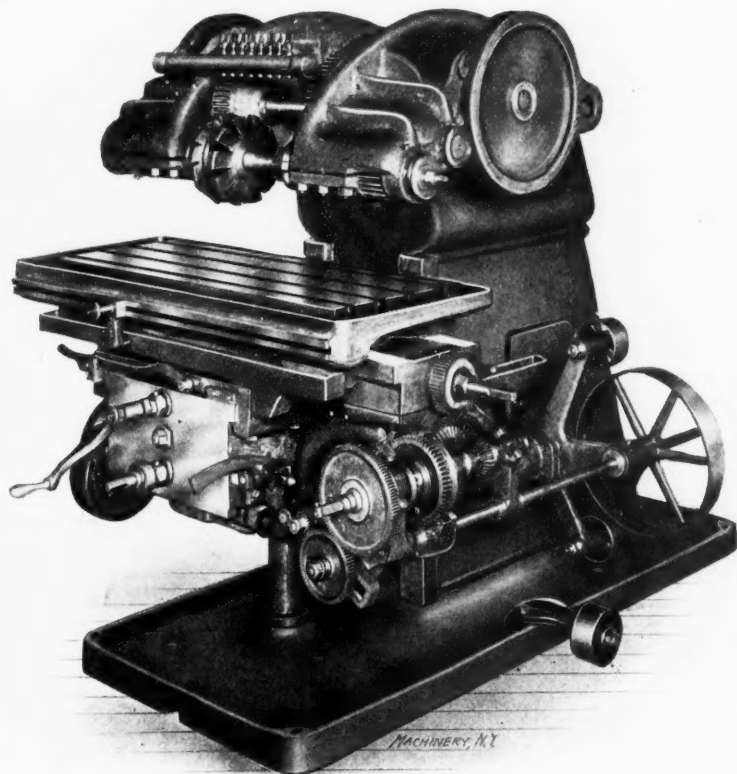
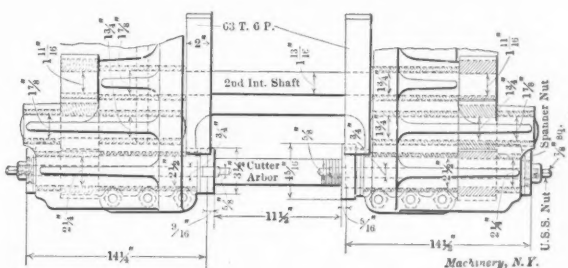
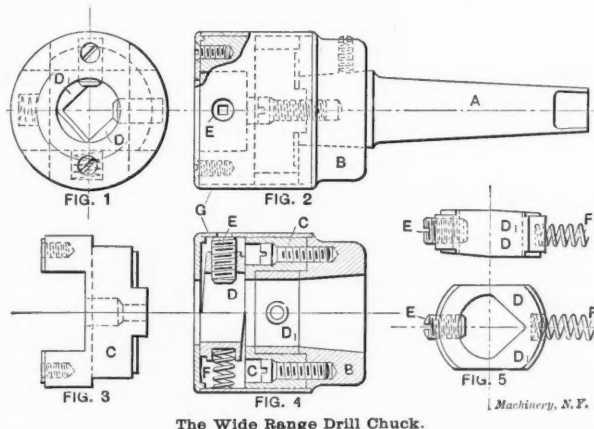


Fig. 1. Walcott Automatic Rack Cutter.

groove of the first jaw *D*. The setscrew in the jaw *D*₁ (which is identically similar to *D*, although located at right angles to it) is next tightened, which centers the tool vertically. The movement necessary for this last centering is permitted to the tool because, while it is tightly held in jaw *D*, this jaw itself is free to move vertically, against no other resistance than that of spring *F*; when the two screws are tightened the tool is centered and securely held. Since the two jaws are similarly placed, either of them may be tightened first. It will be noted that jaws *D* and *D*₁ are slightly beveled on the opposite faces, from the center line to the opposite ends. This construction permits the holding of taper shanks as



ed; the one on the longitudinal feed screw of the table is changed to suit the pitch of the rack being cut, while another set mounted at the front of the mechanism is changed to agree with the number of teeth being cut at one time. If, for instance, four 6-pitch teeth are being cut at one time the gears at the front will be set for four teeth while those on the screw will be set for 6-pitch. The indexing mechanism is operated entirely by positive clutches and gears, there being no friction slip to get out of adjustment and consumed power. For centering a cutter in a tooth space already cut, the index gear on the longitudinal screw is mounted on a friction bearing, which can be tightened by means of the nut shown. With the nut loosened the table may be set at any required point to bring the cutter and tooth studs to the proper position. The gear is then tightened and the indexing proceeds.

A dog at the front of the table operates a lever which trips a chain on the left side of the machine, not plainly shown in the cuts. This chain is connected with the countershaft, as was before mentioned, and stops the machine when any desired position on the rack has been reached by the cutter. The base of the machine is formed to act as an oil tank and is provided with an oil pump. Suitable arrangements are provided for distributing the oil over the cutters and for returning it to the tank. The net weight of the machine is a little over 5,000 pounds.

* * *

OBITUARY.

Dwight Slate, president of the Dwight Slate Machine Company, Hartford, Conn., died July 31 at his home in that city. He was born May 29, 1816. Mr. Slate was the inventor of the lathe taper attachment and the sensitive drill press and other improvements of machine tools. An extended biographical sketch of Mr. Slate, with portrait, appeared in the July issue.

Daniel B. Wesson, of the well-known firm of revolver manufacturers, Smith & Wesson, died at his home in Springfield, Mass., August 4. Mr. Wesson was born in Worcester, Mass., in 1825. He was closely identified with the early improvement of firearms and is credited with the invention of the metallic case ammunition now universally used in all breech-loading small arms, but this is disputed, the invention being claimed by some as that of C. D. Leet of Springfield, Mass. The firm of Smith & Wesson had its inception in 1852 at Norwich, Conn., but the manufacture of revolvers did not begin in Springfield until 1857. The outbreak of the Civil War gave a great impetus to the business and it became very successful.

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PERSONAL.

Frederick Hitchcock, of Meriden, Conn., has been made principal of the Manual Training School of New London, Conn.

Redfield Allen, for the past five years chief draftsman of the engineering department of the Fore River Shipbuilding Co., has resigned.

John W. Pilling, formerly of Waterbury, Conn., has been appointed assistant superintendent of the mill department of the Seymour Mfg. Co., Seymour, Conn.

H. J. Bachmann, a frequent contributor to MACHINERY, has severed his connection with the Mergenthaler Linotype Co. and has accepted a position as superintendent of the Alton Mfg. Co., of New York City.

H. A. Sedgewick, for several years superintendent of Gay & Ward, Inc., Athol, Mass., and later connected with the Union Twist Drill Co., successor of the above firm, has resigned his position to become superintendent of Madison-Kipp Lubricator Co., Madison, Wis.

FRESH FROM THE PRESS.

THE ANALYSIS AND SOFTENING OF BOILER FEED-WATER. By Edmund and Fritz Wehrenfennig. Translated from the German by D. W. Patterson. 290 pages, 6 by 8 inches, and 171 cuts. Published by John Wiley & Sons, New York. Price \$4.00.

This book in review is of the second edition, and is, perhaps, the most valuable treatise on the subject of boiler feed water analysis and

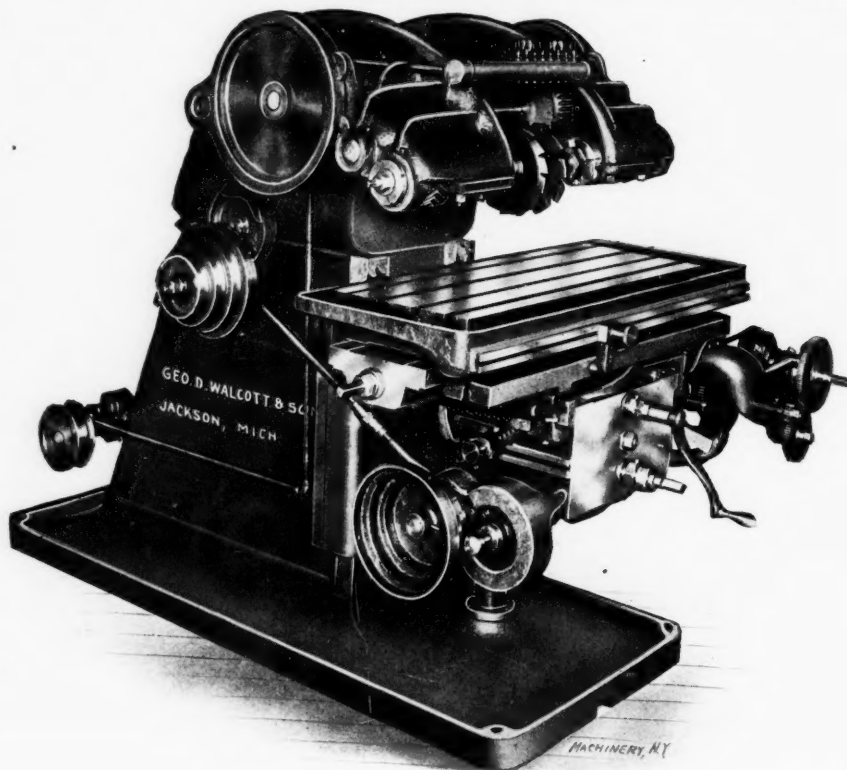


Fig. 3. Left Side View of Walcott Rack Cutter.

softening now available in England—thanks to Mr. Patterson, the translator, who had found it invaluable in his work. Of the Wehrenfennings, the first named is chief inspector of the Austrian Northwestern Railway in Vienna, and the second is an analytical chemist and director of factories in Eggenburg. By chapters the topics are as follows: Impurities in Feed-water; The Analysis of Water; Preparation of the Necessary Chemicals for Water Analysis; The Improvement of Water; Determination of the Amount of Reagents; Testing the Softening; The Removal of Precipitate from the Treated Water; The Accomplishment of Water Purification and the Separate Arrangements Therefor; Review of the Development of Water-purifying Plants; Critical Examination of Water-purifying Plants; Study Concerning the Installation of Water-purifying Plants; Report on Water-softening by the Society of German Railway Managers; Method of Tabulating Data. The book is of special value to railway chemists and others having to do with purification of feed-water for locomotives. This subject is becoming a most important one in railway management, and we shall expect to see a great improvement in present American railway practice in the near future. The book is cordially recommended to all interested.

NEW TRADE LITERATURE.

NATIONAL MCH. TOOL CO., 208 Lawrence Street, Cincinnati, O. Latest pamphlets issued are The Verdict, being made up of letters of commendation of their key-seating tools; and Improved Speed Changers, devoted to description of the new and distinctive features in the design of speed changers.

WHITCOMB-BLAISDELL MCH. TOOL CO., 134 Gold Street, Worcester, Mass. Catalogues of Patent Geared Head Lathes and Whitcomb Planers. The catalogues are arranged with a general description in the front, followed by alternate pages of description and illustration of the various types.

MANUFACTURERS' NOTES.

THE BATES FORGE CO., Indianapolis, Ind., are making a large addition to their plant that will double their capacity. Most of the new machinery has been contracted for.

THE NATIONAL-ACME MFG. CO., Cleveland, O., announce that their New England office, formerly located at 176 Federal Street, Boston, Mass., was transferred to 95 Liberty Street, New York City, on August 1st. Mr. M. M. Brunner continues in charge.

THE LINK BELT MACHINERY CO., Chicago, Ill., under its new name, the Link Belt Co., has purchased the plants and all other assets of its associate companies—the Link Belt Engineering Co., Philadelphia, Pa., and the Ewart Mfg. Co., Indianapolis, Ind. It will maintain the offices and operate the plants as now established.

MR. ARTHUR APPLETON has been made resident manager of the New York office, at 45 Broadway, of Pawling & Harnischfeger, Milwaukee, Wis., builders of traveling cranes, and will represent this firm's interests in and about New York City, the New England States and Eastern Canada. Mr. Appleton was formerly associated with William Sellers & Co., Philadelphia, for many years as traveling salesman.

THE BATH GRINDER CO., Fitchburg, Mass., has been reorganized and incorporated as a company under the Massachusetts laws with John Bath, president; Arthur Goodnow, vice-president; Robert D. Gould, treasurer. The capital stock is \$40,000, of which \$20,100 has been issued. The concern started about three years ago with only two men; the business has increased to such an extent that now the entire first floor of the Putnam Machine Co.'s shop is required for the business. The number of employees has increased to twenty-five and further additions to the force shall be made in a short time.

